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ASPECTS ON DESIGNING THE INDUCTION GYROMOTOR WITH A MERCURY LIQUID ARMATURE AS AN ANGULAR MOMENTUM CARRIER

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Abstract: *This work presents some considerations related to the determination and calculation of the parameters of gyromotor with double toroidal stator and mercury armature. The determinant parameter which influences the operation of gyromotor is the value of angular momentum determined by the velocity and the mass of mercury used as an angular momentum carrier. After we have determined the manner of choice of the parameters necessary for the design, the equivalent circuits are made. The presence of two inductors disposed on one side and on the other side of the armature as well as the dimension much bigger of air gap between them, the dimension that can be of 10-15 times bigger than at the classical cylindrical asynchronous machines, make that the problem of mutual coupling between the two inductors to be variable and so to be three types of equivalent circuits, depending on the type of magnetic coupling between the inductors. The important remark is that at the gyromotor with bilateral toroidal inductor and mercury disk-armature, the synchronism velocity of induction field depends on the number of poles like at the cylindrical asynchronous machines but having the armature of disk type, the synchronism velocity can also be considered as a synchronous tangential velocity.*

Keywords**:** *gyromotor***,** *mercury, circuit, pole*

1 THE SELECTION OF MERCURY GYROMOTOR PARAMETERS

The determinant parameter which influences the operation of gyromotor is the value of angular momentum determined by the velocity and the mass of mercury used as an angular momentum carrier.

If we consider that a high velocity of mercury armature depends on the synchronism velocity of the field and on the shape and the section of the mercury enclosure, namely, it is determined by a high quality factor or a good magnetic interaction on the air gap level, it results that we have to act on all the building elements of gyromotor with the object of ensuring some convenient values for technical indicators of gyromotor. The quality factor estimates the capacity of induction machine to produce an optimum electromagnetic conversion.

The relation which defines the quality factor Q is the ratio between the magnetizing reactance and the phase resistance of the armature, the mercury in case of a gyromotor:

$$Q = \frac{X_m}{R_2} \tag{1}$$

It has been found from the relation (1) that the mercury gyromotor, supplied from a constant voltage source, has a high performance when for the same exciting current it can generate a higher flux.

Laithwate determined the expression of quality factor starting from the relation (1) and by consecutive transformations he obtained the relation of quality factor:

$$Q = \frac{2 f_1 \mu_0 \tau^2}{\pi \rho_r \delta'} \tag{2}$$

where: μ_0 – magnetic permeability of air gap space (relative magnetic permeability of mercury $\mu_r = 0.99999981$);

- ρ_r – surface resistivity of armature;
- δ' – air gap of a magnet;
- τ_p – pole pitch;
- f_1 – frequency of inducing currents.

The surface resistivity of armature is defined by the expression:

$$\rho_r = \frac{\rho_{Hg}}{\Delta} \cdot K_P \tag{3}$$

where: ρ_{Hg} – resistivity of mercury used as an armature for the gyromotor built and tested;

- Δ – thickness of mercury enclosure;
- K_p – correction factor of mercury armature resistivity due to the transverse effect. $K_p > 1$.

The magnetic air gap δ_{mg} is given by the relation:

$$\delta_{mg} = K_c^{'} \cdot \delta \tag{4}$$

where: K_c' – Carter's factor for the gyromotor with two inductors ($K_c' = K_c^{\ 2}$).

By means of the relations (3) and (4), the quality factor expression can be written:

$$Q = \frac{2 \cdot f_1 \cdot \mu_0 \tau^2 \cdot \Delta}{\pi \cdot \rho_{Hg} \cdot K_c^{'} \cdot K_P \cdot \delta} \tag{5}$$

where: f_1 – frequency of inducing currents.

- μ_0 – magnetic permeability of air gap space (relative magnetic permeability of mercury $\mu_r = 0.99999981$);
- τ_p – pole pitch;
- Δ – thickness of mercury enclosure;
- ρ_{Hg} - resistivity of mercury used as an armature for the gyromotor built and tested;
- K_c' – Carter's factor for the gyromotor with two inductors;
- K_p – correction factor of mercury armature resistivity due to the transverse effect. $K_p > 1$.

The performances of mercury armature gyromotor can be estimated from the analysis of quality factor.

Further on, it is analysed the influence of the values from the definition relation of the quality factor.

For the mercury armature gyromotors, the air gap δ includes the spaces occupied by the insulations placed on one side and on the other side of the armature, with a value imposed by the electrical insulation between the mercury and the inductor and by the mechanical safety as well as by the thickness Δ of mercury disk-armature imposed by the rotation of conducting fluid and the resistance to flow of induced currents.

To obtain the necessary performances imposed both by the quality factor and those imposed by resulting an angular momentum high enough, the extension of the air gap requires a significant increase of inducing current layer. For this purpose, it was used a double inductor which under certain conditions allows the significant increase of current layer depending on the electromagnetic coupling between the two inductors.

To make clear this problem, further on, we shall present some aspects related to the double inductor machines, a problem which was not treated in literature.

2 THE DETERMINATION OF EQUIVALENT CIRCUITS

The presence of two inductors disposed on one side and on the other side of the armature as well as the dimension much bigger of air gap between them, the dimension that can be of 10-15 times bigger than at the classical cylindrical asynchronous machines, make that the problem of mutual coupling between the two inductors to be variable.

So, in case that the air gap $\delta = 0$ or is very small. The two inductors can be considered as just one with a double number of turns in each slot leading to an increase of 4 times of magnetizing reactance.

In case of very big air gaps between the two inductors there is no mutual coupling and in this situation, the electrical machine can be considered as being formed of two independent electrical machines running in parallel on the rotor, the magnetizing reactance being double in relation to the magnetizing reactance of a classical rotary induction machine.

The common situation is that in which between the two inductors there is a partial magnetic coupling depending on the size of the air gap (Fig.4).

In this situation the magnetic flux linking the turns of induction circuit is formed of three components:

- the useful magnetic flux Φ_{uI-II} which links the turns of both windings disposed on the two stators and crosses the air gap δ in which the disk-rotor is;
- the useful magnetic fluxes Φ_{uI} and Φ_{uII} which link the turns of each winding and partially parts of the armature of the motor;
- the magnetic leakages Φ_{dI} and Φ_{dII} which link the turns of each winding and partially parts of the common armature.

Each flux has a reactance which appears both in the operating equations and the equivalent circuits necessary to the calculation of motor characteristics.

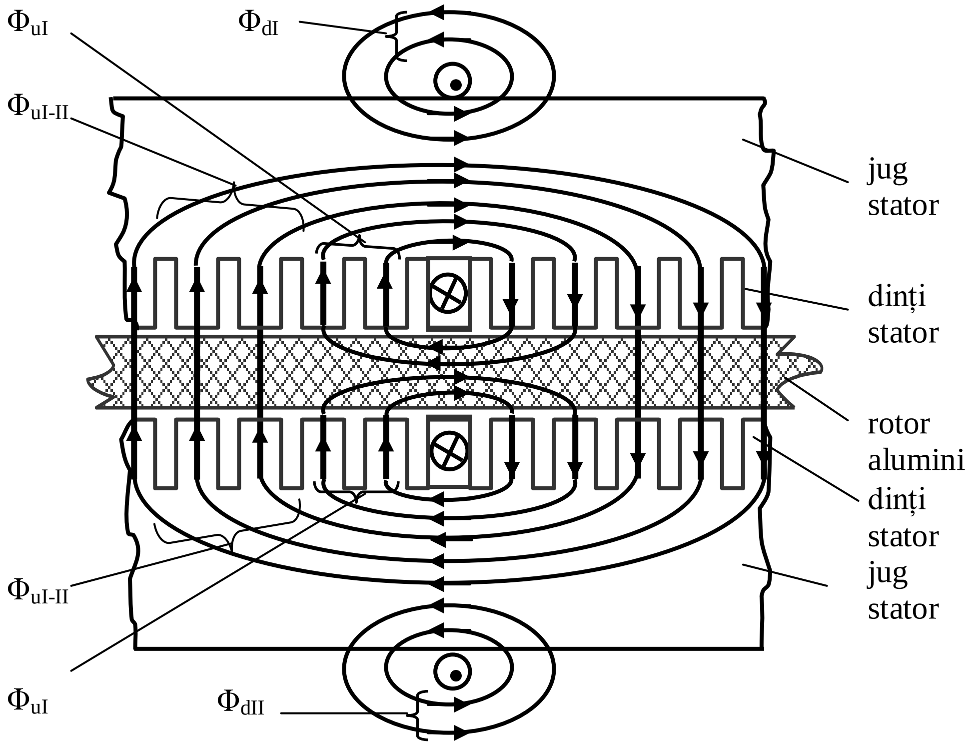

Fig. 1 – The magnetic fluxes in magnetic inducting circuit

The resistances of inducting windings, the resistance of armature related to the inductor, the leakage reactances of the two inducting windings and the resultant magnetizing reactance appear in the equivalent circuits of asynchronous motors with double inductor and plane air gap.

According to the three situations mentioned above we note three equivalent circuits (Figs.2, 3 and 4):

- the equivalent circuit when there is no magnetic coupling;
- the equivalent circuit when there is a maximum magnetic coupling;
- the equivalent circuit when there is a partial magnetic coupling;

To explain these phenomena it was considered that the two inducting windings are connected in series.

To take into account the coupling of the two inductors, it is introduced a calculation coefficient K_{CM} of the magnetizing reactance with a value depending on the size of the air gap.

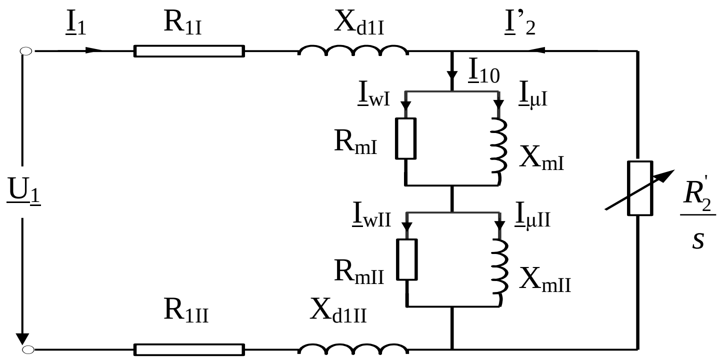

Fig. 2 - The equivalent circuit when there is no magnetic coupling

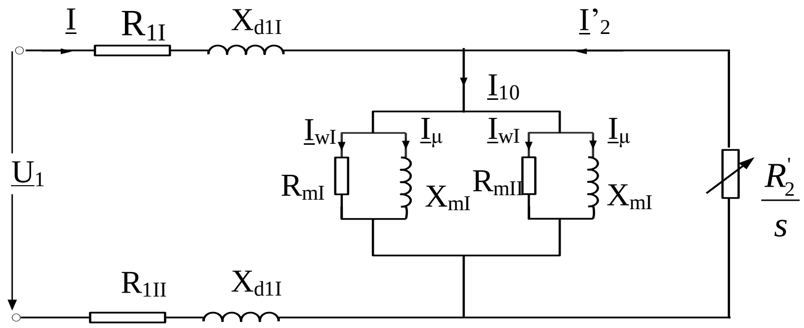

Fig. 3 - The equivalent circuit when there is a maximum magnetic coupling

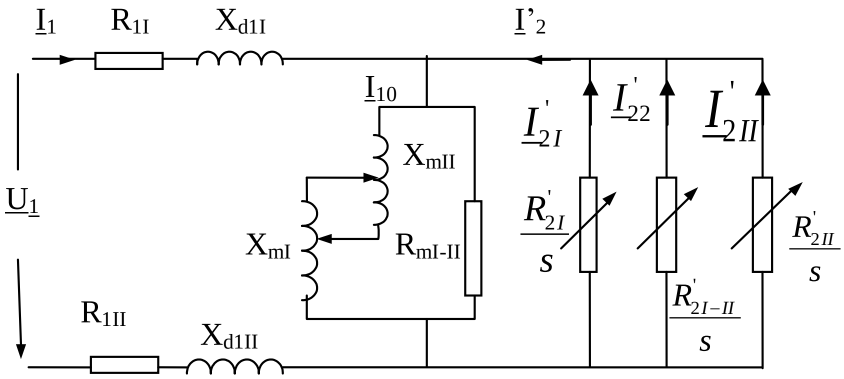

Fig. 4 - The equivalent circuit when there is a partial magnetic coupling

When the magnetic coupling is perfect at an air gap near to zero, K_{CM} = 2 and when the air gap is big enough so that it is considered that the two inductors don't influence each other, K_{CM} = 1.41.

In this situation, the magnetizing reactance for the upper harmonic of magnetic field has the expression:

$$X_{m1} = 1{,}6 m_1 \frac{f_1}{100}\left(\frac{K_{CM} w_1 k_1}{100}\right)^2 \frac{\tau_{med}}{100 k_C^2}\frac{l}{p} \qquad (6)$$

where: K_{CM} - coefficient of magnetic coupling

m_1 – number of motor phases

f_1 - frequency of supply voltage

w_1 – number of turns disposed on a stator

k_w – winding factor

k_C – Carter's coefficient

τ_{med} - average value of pole pitch

l – active length of conductors in cm

p – number of pole pairs.

3 THE AIR GAP

A big air gap requires a high magnetizing current and consequently, the power factor, cosφ will decrease leading to the increase of losses and to the reduction of performance.

But taking into account that the performance criteria in building the gyromotors are: safety in operation, the value of angular momentum which influences both the stability in meridian of the gyro-compass and the sensibility in designing and building the gyromotors, the power factor, the efficiency and losses have not the importance which they have at the industrial motors.

4 THE POLE PITCH

The length of the pole pitch τ depends on the velocity of the mercury armature to obtain the imposed angular momentum.

The size of the pole pitch and the frequency of supply voltage impose the value of synchronous velocity of the mercury armature of the gyromotor with toroidal inductors:

$$v_1 = 2 \cdot f_1 \cdot \tau_p \tag{7}$$

The value of the pole pitch τ_p is determined by the number of phases, m, the number of slots on the pole and phase, q, and the pitch of teeth τ_d :

$$\tau_p = m \cdot q \cdot \tau_d \tag{8}$$

The pitch of teeth is given by the sum of two terms, as it also results from the Figure 5 showing a slot detail:

$$\tau_d = b_c + b_{dmed} \tag{9}$$

where: b_c – width of slot

$b_{d\ med}$ - average width of tooth, taking into account that the tooth has a trapezoidal shape.

The important remark is that at the gyromotor with bilateral toroidal inductor and mercury disk-armature, the synchronism velocity of induction field depends on the number of poles like at the cylindrical asynchronous machines but having the armature of disk type, the synchronism velocity can also be considered as a synchronous tangential velocity.

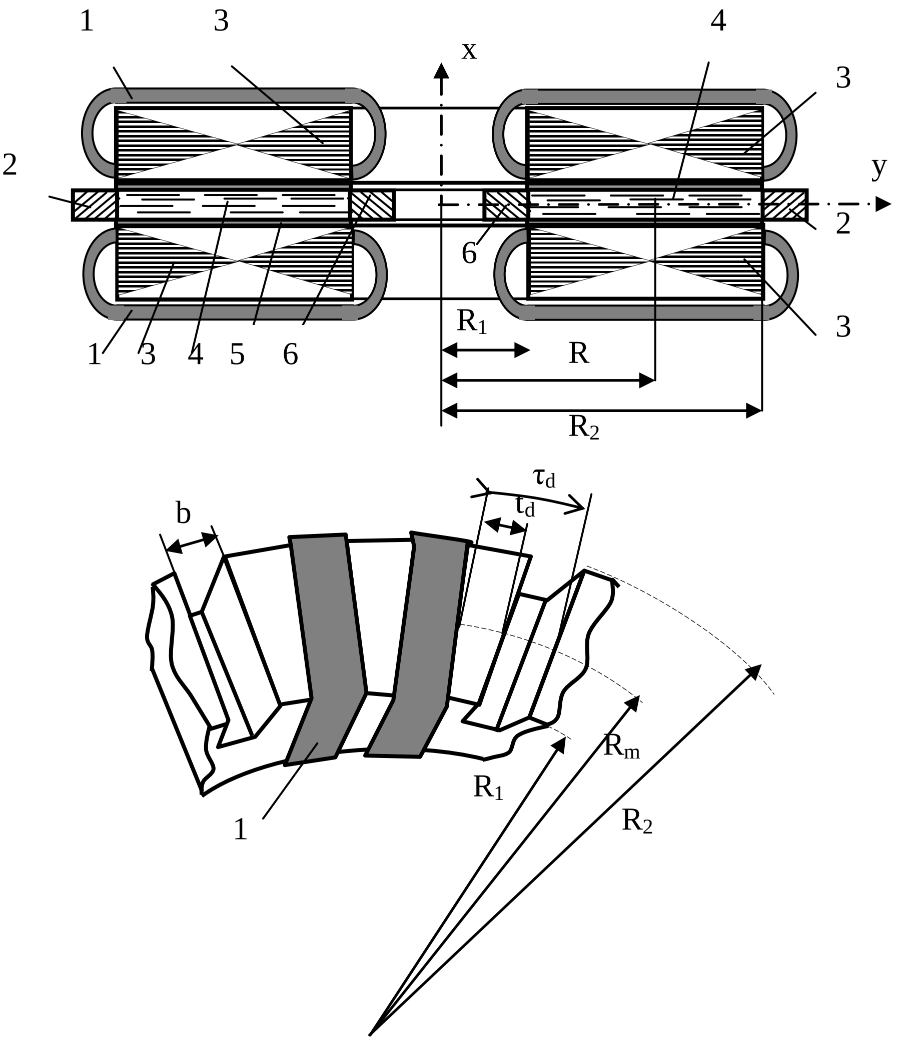

Fig. 5 – The building detail of the mercury armature gyromotor

The synchronism velocity of induction field will be considered as a tangential velocity at the average radius of the armature allowing the determination of an equivalent rotational synchronous velocity of the mercury armature n_s by means of:

$$n_s = \frac{30 v_s}{\pi \cdot R_{med}} \tag{10}$$

where: R_{med} - the average radius of mercury armature considering the tangential velocity v_s, the average radius being considered as a mean value between R_1 and R_2;

R_1 and R_2 are the minimum and maximum radii of toroidal armature.

In Figure 5 there are presented a part of an inductor and the building details of mercury armature gyromotor in which: 1 – ring winding; 2 – outer locking ring of mercury enclosure; 3 – magnetic core of toroidal inductor; 4 – mercury enclosure; 5 –

insulating material disks for locking the mercury enclosure; 6 – inner locking ring of mercury enclosure.

5 THE NUMBER OF POLES

At the toroidal inductor gyromotor, the length of magnetic circuit of inductors is imposed by the radius of the circle in which the inductor is inscribed.

From the tests made with the model built, it has been found the necessity that the difference between the radii R_2 and R_1 (Fig.5) to have such a value that the angular velocities of fluid layers should be of neighbour values, thus there is an optimum between thr differences of the two radii.

In the pre-dimensioning calculations, we shall choose the widths of the slots suitable to the preliminary power. In the initial data, it is imposed the value of angular momentum which has to be obtained and from this results the angular velocity and hence the tangential velocity resulting the pole pitch τ_p and consequently, the number of poles can be determined. For the toroidal inductor, the relation which gives the average circle length of an inductor is:

$$L_{med} = 2p \cdot \tau_{med} \tag{11}$$

where: 2p – number of poles; τ_{med} - average pole pitch

6 CONCLUSIONS

The quality factor increases with the length of the poles and accordingly, at an imposed length of the inductor, the increase of the quality factor and the velocity is obtained by reducing the number of pole pairs. Preferably, the best choice is for two poles, taking into account that at the gyromotor with toroidal inductor and disk-armature, even if it can be compared with a linear motor, the negative effects specific to the linear motor don't appear as it would be the longitudinal effect because the inducting magnetic circuit is continuous.

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ASPECTS ON THE CALCULATION OF REACTANCES OF A TOROIDAL INDUCTOR GYROMOTOR

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Abstract: *This work presents some specific aspects on the calculation of reactances of a gyromotor with double toroidal inductor. The first part presents the equivalent circuit of the gyromotor by comparison with the equivalent circuits of a classical asynchronous motor. Taking into account the distance between the inductors, the equivalent circuit was considered for a partial coupling in which the resistance* $R'_{2ll}/2$ *was neglected because it had a very low value. Like at the asynchronous induction machines under various operating conditions, the parameters of toroidal inductor gyromotor don't remain constant. So, the total magnetic flux linking the magnetic circuit of the gyromotor can be considered as being the sum of two components: a component linking the threads of mercury fluid of the armature named useful flux; a sum of fluxes which don't link the mercury fluid threads but only their own turns named leakage flux. Each component of the flux has its own magnetizing reactance* X_m *and leakage reactance* X_s *which will be determined later on in this work.*

Keywords: *circuit, toroidal, gyromotor, reactance*

1 THE EQUIVALENT CIRCUIT OF A DOUBLE INDUCTOR GYROMOTOR

The elements of a toroidal inductor gyromotor's circuit, on the analogy of that of the rotational asynchronous motors with cylindrical and linear inductor, are the resistance (R_1) and the leakage reactance (X_1) of the inductive winding and the induced plate resistance (R_2), the leakage reactance (X_2) of the induced plate, the magnetizing reactance (X_m), the calculation resistance (R_m) through which the losses in the inductive magnetic circuit are taken into account.

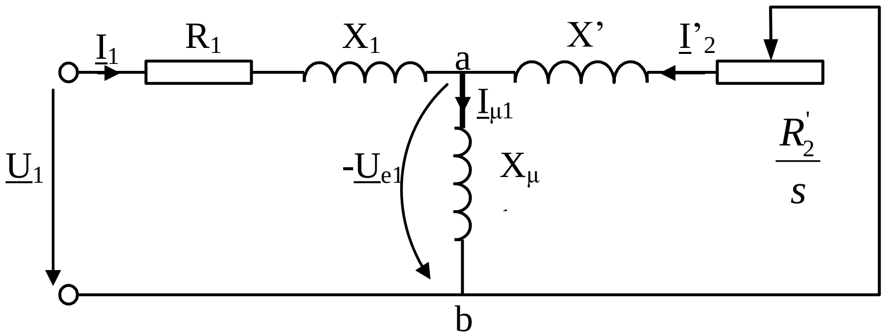

Fig. 1 – The equivalent circuit of a classical induction rotary machine in short-circuit with negligible iron losses

The equivalent circuits of a phase of a classical induction rotary machine in short-circuit with negligible iron losses are presented in Fig.1 and with considering the iron losses in Fig.2.

Like at the transformers where the magnetic circuit has no air gap, the magnetizing current represents 5% of the machine current. The rest of the current of 95% is used for power generation on the motor shaft and it is found in rotor.

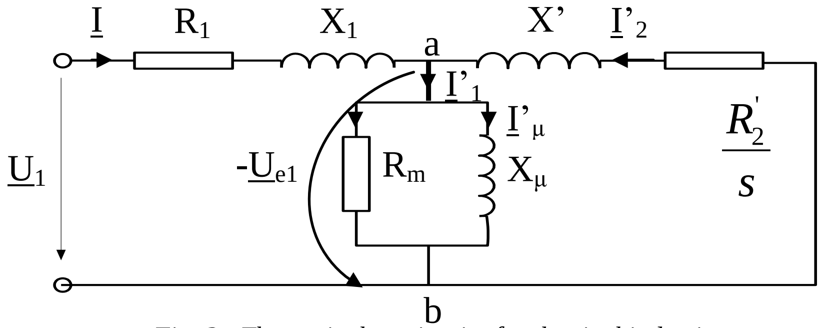

Fig. 2 - The equivalent circuit of a classical induction rotary machine in short-circuit with iron losses

Taking into account the distance between the inductors, the equivalent circuit of the gyromotor with a toroidal inductor and mercury armature with a partial magnetic coupling differs from the equivalent circuits of classical motors and is presented in Fig.3. The rotor reactance in mercury is very low (and it has only one turn) $w_2 = 1$.

The armature resistance related to the primary one R'_2 for the gyromotor represents the mercury resistance.

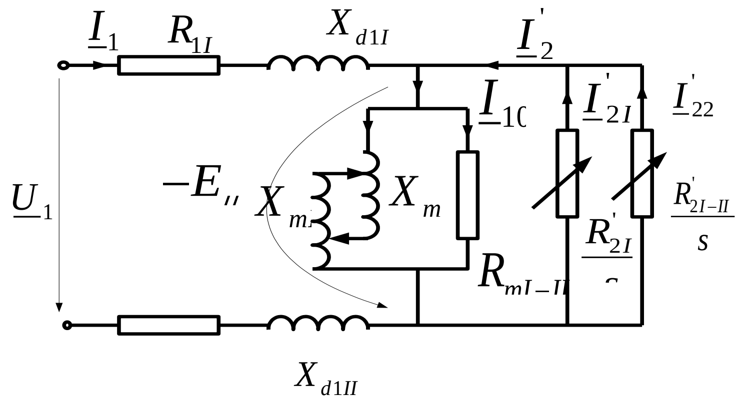

Fig. 3 – The equivalent circuit of the gyromotor with partial coupling, double toroidal inductor and mercury armature

The machine current has two components, a part of it is used for magnetic flux generation and represents the magnetizing current which is the lower when the air gap is the smaller. At the transformers where the magnetic circuit has no air gap, the magnetizing current represents 5% of the machine current.

The rest of the current of 95% is used for power generation on the secondary terminals or in case of rotary machine for power generation on the motor shaft and it is found in rotor.

According to the equivalent circuit in Fig.3 the following equations can be written:

$$\underline{U}_1 = R_{1I}\,\underline{I}_1 + jX_{d1I}\,\underline{I}_1 + R_{1I}\,\underline{I}_1 + jX_{d1II}\,\underline{I}_1 - \underline{E}_\mu \tag{1}$$

$$0 = \frac{R'_{2I}}{s}\,\underline{I}'_{21} - \underline{E}_\mu \tag{2}$$

$$0 = \frac{R'_{2I-II}}{s}\,\underline{I}'_{22} - \underline{E}_\mu \tag{3}$$

$$\underline{I}_1 + \underline{I}'_2 = \underline{I}_{10} \tag{4}$$

$$\underline{I}_{1a} + \underline{I}_{1\mu} = \underline{I}_{10} \tag{5}$$

$$\underline{I}'_{2I} + \underline{I}'_{22} = \underline{I}_{10} \tag{6}$$

$$\underline{E}_\mu = -j\,\frac{X_{mI}\,X_{mII}}{X_{mI} + X_{mII}}\,\underline{I}_{1\mu} = -R_{mI-II}\,\underline{I}_{1a} \tag{7}$$

The component of iron losses I_{1a} is given by the relation:

$$I_{1a} = \frac{P_{Fe1}}{E_\mu} = \frac{E_\mu^2}{R_{mI-II}} \tag{8}$$

where: P_{Fe1} - iron losses in stator;

R_{ml-ll} – a resistance which, being passed by the current I_{1a} , would generate by Joule effect a loss with a power equal with the losses P_{Fe1}.

Like at the asynchronous induction machines under various operating conditions, the parameters of toroidal inductor gyromotor don't remain constant. So, the total magnetic flux linking the magnetic circuit of the gyromotor can be written as being the sum of two components:

$$\Phi_{1t} = \Phi_m + \Phi_s \tag{9}$$

where: Φ_m – is the component linking the threads of mercury fluid of the armature named useful flux;

Φ_s - is a sum of fluxes which don't link the mercury fluid threads but only their own turns, named leakage flux.

Each component of the flux has its own magnetizing reactance X_m and leakage reactance X_s.

2 THE MAGNETIZING REACTANCE

For the cylindrical asynchronous machines, the magnetizing reactance of a winding distributed for the upper harmonic is given by the expression:

$$X_m = 1{,}6 m_1 \frac{f_1}{100}\left(\frac{w \cdot k_w}{100}\right)^2 \frac{\tau}{100 \cdot \delta \cdot K_C^2} \frac{l_i}{p} [\Omega] \tag{10}$$

where:

m_1 – number of phases;

f_1 – frequency of supply voltage;

w – number of turns on phase connected in series;

K_w – the winding factor of main wave on phase of inductor winding;

p- number of pole pairs;

τ – pole pitch;

δ – length of magnetic air gap (cm);

l_i – ideal length of armature (cm).

For the toroidal inductor gyromotor the ideal length of cylindrical motor's armature is compared with the width of the inductor (R_2 – R_1).

The magnetizing reactance of a linear double inductor fitted with ring winding and of finite length is:

$$X_m = 2\pi f_1 \cdot \mu_0 \frac{(2w_b)^2 \tau_d \cdot l}{K_C^2 \cdot \delta}\left(\frac{p(30p+14)}{3(6p+1)}\right)^2 [\Omega] \tag{11}$$

where:

K_C – Carter's factor which is transformed into K_C^2 for bilateral motors;

w_b – number of turns of a slot;

τ_d - pitch of teeth;

l – width of inductor $l = R_2 - R_1$.

In case of the gyromotor with a closed double toroidal inductor, the expression (10) can be used for calculating the magnetizing reactance in which l_i is replaced by (R_2 – R_1):

$$X_m = 1{,}6 m_1 \frac{f_1}{100}\left(\frac{2w \cdot k_w \cdot k_\delta}{100}\right)^2 \frac{\tau}{100 \cdot \delta \cdot K_C^2} \frac{(R_2 - R_1)}{p} [\Omega] \tag{12}$$

where:

k_δ - is a coupling factor of the two inductors depending on the air gap and smaller than 1 and it isn't presented in the literature.

In case of a partial coupling between the inductors the following expression is used:

$$X_m = 1{,}6 m_1 \frac{f_1}{100}\left(\frac{K_{CM}\cdot w\cdot k_w}{100}\right)^2 \frac{\tau_{med}}{100\cdot K_C^2}\frac{(R_2 - R_1)}{p}[\Omega] \tag{13}$$

3 THE LEAKAGE REACTANCES PROPER TO THE GYROMOTOR WITH TOROIDAL STATOR AND RING WINDINGS

The inductive reactances are expressed depending on the frequency and the inductivity, by reactance X = ωL, respectively.

For a winding (with a total number w_x of turns on slot) placed on a slot, the inductance and the flux of w_x conductors are:

$$L = \frac{w_x \Phi_x}{i}; \qquad \Phi_x = \frac{w_x i}{R_m} \tag{14}$$

The magnetic permeability (permeance) being the reciprocal of the magnetic reluctance, it results the medium through which the considered flow is closed:

$$\Lambda = \frac{1}{R_m} = \frac{1}{\frac{l}{\mu S}} = \mu \frac{S}{l} \tag{15}$$

where:

l – is the length of considered magnetic circuit;

S – section of magnetic circuit.

According to the relation (15), the permeance is a value proportional to the magnetic properties of the medium through which the magnetic leakage flux is closed and it depends on the geometrical dimensions of the closing line.

When the leakage flux is closed by air it can be admitted $\mu = \mu_0$.

The specific permeance can be defined as a function of geometrical dimensions only when the estimates are made at the same magnetic material.

The specific permeance (λ'_x) represents the permeance of the leakage flux on the length unit of a turn.

The relations (14) become:

$$\Phi_x = w_x \Lambda_x i = \mu_0 w_x \lambda_x' l_x i \tag{16}$$

$$L = \mu_0 w_x^2 \lambda_x' l_x \tag{17}$$

For a phase of a ring winding placed in q slots, with p pole pairs, and a number of w turns, the leakage inductance is:

$$L = \mu_0 \frac{w^2}{2p\cdot q}\cdot \lambda_x \cdot l_x \tag{18}$$

where: l_x - is the length of a turn;

λ'_x - specific permanence equivalent to a leakage flux linking the total number of conductors disposed in slots.
The leakage reactance of the whole phase with serial-connected coils is:

$$X_1 = \omega \cdot L_s = \pi f \mu_0 \frac{w^2}{pq} \lambda_x \cdot l_x \tag{19}$$

Therefore, the calculation of the reactances is reduced to the determination of the permeances of flux tubes, more exactly, of their geometrical dimensions because de closing medium is known, being the air.

4 THE LEAKAGE REACTANCE DUE TO THE INACTIVE SIDES OF RING WINDINGS

The volume through which the total flux is closed is divided into elementary volumes (concentric cylinders, torus with a circle quarter section) with calculation relations of permeances.

For a bilateral gyromotor with two symmetrical magnetic circuits A_1 and A_2 , with open-slots placed on one side and on the other side of an air gap δ, the surfaces crossed by the force lines of the leakage flux are (Fig.4): the upper surface of inductor S_{A1} ; the outer surface of yoke S_{Aje} ; the outer surface of teeth S_{Ade} ; the surface of outer torus S_{Ate} ; the inner surface of yoke S_{Aji} ; the inner surface of teeth S_{Adi} : the surface of inner torus S_{Ati}.

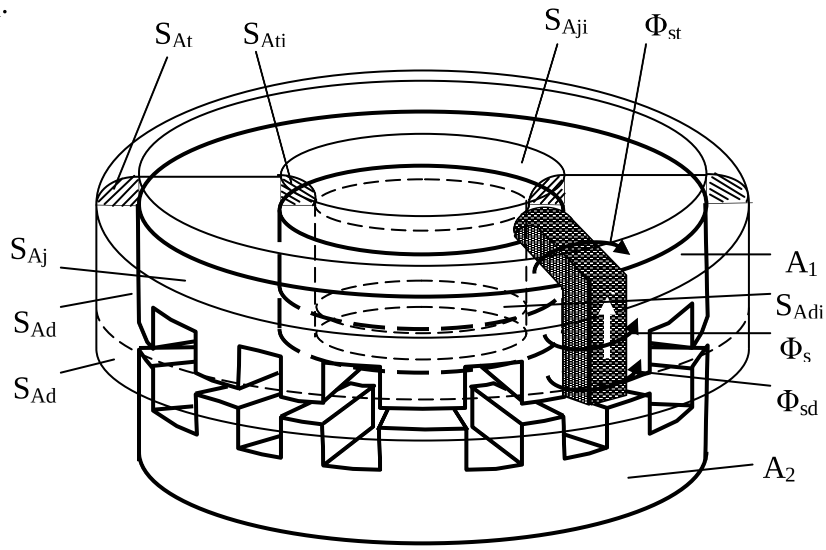

Fig. 4 – The surfaces crossed by the leakage fluxes at the bilateral toroidal gyromotor

The flux Φ_{S1} through the surface S_{A1} has a permeance:

$$\lambda_{1-2} = \mu_0 l_I \left[0{,}26 + \frac{1}{\pi} \ln\left(1 + \frac{4\tau_{dmed}}{b_c} \right) \right] \tag{20}$$

where: τ_{dmed} - is the average pitch of teeth.

The permeance of the flux Φ_{Sje} through the outer surface S_{Aje} of yoke is:

$$\lambda_{3-4} = \mu_0 h_j \left[0{,}26 + \frac{1}{\pi} \ln \left(1 + \frac{4\tau_{dM}}{b_c} \right) \right] \tag{21}$$

where: τ_{dM} – is the pitch of teeth at the maximum diameter of inductor.

The permeance of the flux Φ_{Sde} through the surface S_{Ade} of teeth is:

$$\lambda_{5-6} = \mu_0 h_d \left[0{,}26 + \frac{1}{\pi} \ln \left(1 + \frac{4\tau_{dM}}{b_c} \right) \right] \tag{22}$$

where: h_d – the height of teeth.

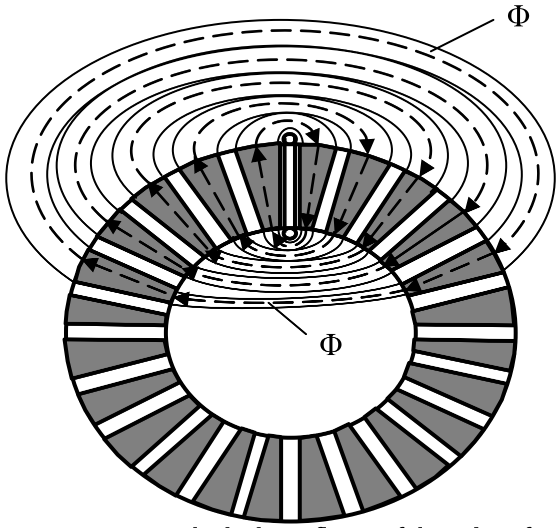

Fig. 5 – The leakage fluxes of the sides of teeth

Similarly, the permeances of yoke and teeth closing through the inner surfaces of torus are:

$$\lambda_{7-8} = \mu_0 h_j \left[0{,}26 + \frac{1}{\pi} \ln \left(1 + \frac{4\tau_{dm}}{b_c} \right) \right] \tag{23}$$

$$\lambda_{9-10} = \mu_0 h_d \left[0{,}26 + \frac{1}{\pi} \ln \left(1 + \frac{4\tau_{dm}}{b_c} \right) \right] \tag{24}$$

where: τ_{dm} – is the pitch of teeth of the minimum diameter of torus;

h_j - height of yoke;

h_d – height of teeth;

The permeance of the volume with a section S_{Ate} is:

$$\lambda_{11-12} = \mu_0 (0{,}5\tau_{dM} + 0{,}077 b_c) \tag{25}$$

The same permeance is found in the lower part of torus, in the slot area, so:

$$\lambda_{13-14} = \mu_0 (0{,}5\tau_{dM} + 0{,}077 b_c) \tag{26}$$

Similarly, the permeance of the upper surface S_{Ati} is:

$$\lambda_{15-16} = \mu_0 (0{,}5\tau_{dm} + 0{,}077 b_c) \quad (27)$$

and of the lower part:

$$\lambda_{17-18} = \mu_0 (0{,}5\tau_{dm} + 0{,}077 b_c) \quad (28)$$

It results that the permeance of the leakage flux surrounding a coil in a slot, out of it, is a sum of permeances, so:

$$\sum \lambda_s = \lambda_{1-2} + \lambda_{3-4} + \lambda_{5-6} + \lambda_{7-8} + \lambda_{9-10} + \lambda_{11-12} + \lambda_{13-14} + \lambda_{15-16} + \lambda_{17-18} \quad (29)$$

In Figure 5 it is presented the closing of the leakage flux outside and inside the inductor.

In case of two serial-connected inductors the proper reactance is:

$$X_\sigma = \frac{2\pi f \mu_0 w_1^2}{pq} \sum \lambda_\sigma \quad (30)$$

5 CONCLUSIONS

The toroidal inductor gyromotor presents a series of features and the accurate determination of useful and leakage fluxes is difficult due to the special shape of the inductor.

The known reactances were taken into account for the three-phase rotary induction motors.

Theoretical considerations were presented for a three-phase winding, in only a layer, with two slots on pole and phase, as the adopted ring winding is, for the considered model of gyromotor.

The relations for calculating the leakage fluxes specific to the gyromotor with toroidal ring winding stator, due to the sides of teeth, the sides of yokes, the upper axial surfaces of yoke, the flux of torus quarter from outside and inside.

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ABOUT PORT SECURITY UNDER THREAT OF TERRORISM

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Abstract: *International Maritime Organization (I.M.O.) with headquarters in London is an Agency of United Nations Organization which attends" to elaboration and implementation of juristic and executive framework considering marine navigation in the international waters. The Committee for Marine Safety of I.M.O. treat problems regarding ships and marine navigation assurance, elaborating and adopting international conventions. One of the most important international conventions elaborated by I.M.O. is The International Convention for Human Life Guarding on the Sea – SOLAS 1974, our country being part of it since 1979. After the events of September 11, 2001, I.M.O. has elaborated and adopted in 2002 "The International Ship and Port Facility Security Code" which is in force since July 1, 2004. In 2002, the ISPS Code is designed to improve security and better protect people and cargo, as well as ports and international shipping, against terrorism. The Code is implemented through Chapter XI-2 „Special Measures to Enhance Maritime Security" in the „International Convention for the Safety of Life at Sea" (SOLAS 1974/1987), being applied by all of the 148 signing states. In essence, the Code ISPS takes the approach that ensuring the security of ships and port facilities is a risk management activity and that, to determine what security measures are appropriate, an assessment of the risks must be made in each particular case. The aim of the paper is to detail the main objects of ISPS Code, the principal risk factors in ports, the implementation impact and the Code application in Romanian ports.*

Keywords: *port, security, terrorism.*

1 RISK FACTORS IN PORTS

The interface between the ship and the port is considered to be a difficult place to control and manage, where the current security measurements may become insufficient. Ports constitute key centers in the context of international maritime transport and distribution chains logistics as well as targets of terrorism. Being situated in vast urbane crowds and representing attractive tourist spots, ports may become easily the place of disasters on the environment and of maritime or deliberate intermodal accidents. So, in ports there are several threats on security among which some refer to goods and others to capital and information flux.

a) Threats on goods:

- In ports there are a lot of goods (means transport, port substructure and superstructure, goods at shipboard or on other means of transport, goods in port stores, equipment, as well as port staff, users etc.), each of these items may become some threaten security unless they are systematically supervised.

- The shifts of goods in ports are accompanied by several operations (transshipment, depositing, manipulating, added value activities, loading – unloading containers) which make them vulnerable.

- In the case of group containers, goods lots are carried to the terminal group storehouse to be loaded in containers a long time before the ship arrival, all the operations implied having a great vulnerability level.

b) Threats on capital and information fluxes:

Capital and information fluxes, communication and/or logistic support ones can be utilized by terrorists as well. This risk can be extended over some components of the distribution chain, inclusively over ports. Some agents act against this risk striding to secure the integrate distribution chains by investing in security systems and IT communication, while others, not taking such measures, increase exposing the whole flux to risk.

Other challenges on the maritime transport security may be: illegal immigration, smuggling, theft and piracy.

2 THE INTERNATIONAL SHIP AND PORT FACILITY SECURITY CODE (ISPS)

The ISPS Code is applied only to commercial ships and ports. The main objectives of the ISPS Code are:

- To detected security threats and implement security measures;

- The establish roles and responsibilities concerning maritime security for government, local administrations, ship and port industries and national and international level;

- To collate and promulgate security-related information;

- To provide a methodology for security assessments so as to have in place plans and procedures to react to changing security levels.

The regulations of the ISPS code refer to a set of compulsory measures for the ship caring out international voyages as well as for the authorities or port administrations and their purpose is to enhancing the security level for ships and port facilities and reducing, as well as possible, the risk of a terrorist attack directed towards the maritime ships, the port facilities or (at worst) towards the ships operating at port terminals.

Applying the ISPS Code, the charges and responsibilities are established of the contracting states governments, ships and navigation companies as well as of the port authorities and port operators. According to the code rules, each contracting state government establishes the security degree at which level the security management system is to be organized and it transmits all information linked with the security systems to the OMI General Secretary.

The code refers to both activities, at the marine ships board and in the ports and it has as aim, first of all, assessing the risk factor regarding a terrorist attack. The proposed security measures differ according to the security level applied, determined by the risk factor assessed. The Code implementation implies achieving a security management system which evaluates (it self) and certifies on the basis of external audit as well as by nominating the persons responsible with the security, both at ships board and in ports and which charges are mentioned.

Applying the Code implies that since 1 July 2004 [1]:

1 No passenger ship, marine drilling unit or goods ship, with brut tonnage over 500 TRB is admitted to operate in port unless it has got “an international ship security certificate” delivered in the name of pavilion state government.
2 Each port facility has got a certificate named “Conformity declaration for port facility” issued in the name of the state government where the facility is situated. In the absence of the document, the respective facility will be considered insecure and it will not be able to be used for maritime ship operation.

All navigation companies and their ships either in property or operated on the basis of some contracts, are to prove that they have realized a security management system which has to correspond to the demands registered in the Code, and the established security degree and to prove conformity by means of certificates issued in the name of the state government where it carries on the activity.

3 SECURITY LEVEL IN PORTS

In case of maritime ships, the security degrees are established by the country government, whose pavilion is raised and in case of port terminals, by the country government on which territory it is placed.

The ISPS Code has got at basis three security levels [2]:

- *The Security Level 1* means the level at which security minimum measures will be maintained, all the time, corresponding to a normal situation.
- *The Security Level 2* means the level for which the security additional measures will be maintained for a while, as a result of the increased risk for a security incident.
- *The Security Level 3* represents the level for which the security protection measures have to be maintained for a limited time in which a security incident is probable or imminent, or it cannot be possible for identifying a specific purpose. Installing the security level 3 can be an exceptional measure which can be applied only when there is the credible information that a security incident is probable or imminent. The security level 3 can be installed only for the identification time of security threat or the security present incident.

Sometimes, the security level changes: from the level 1, through the level 2, to the level 3, but the security level is likely to change directly from 1 to 3.

In this way ports and ports authorities are asked to develop and implement enhancing plans of facility security for each level which are to be approved by the governmental authority in the region where the port is located. Accordingly, the financial, human informative resources will be supplied, inclusively, selecting a security officer for each port facility. These plans are based on the result of the port security assessment and the risk analysis.

4 APPLYING THE ISPS CODE IN ROMANIA

Romania approved implementing the ISPS Code regulations by the Emergency Order nr.80/2003 and by its Norm of applying, approved by the Government Decision nr. 248 since 26.02 2004, and the Romanian Naval Authority is responsible for the charge achievement that the Government of Romania is incumbent out of implanting the ISPS Code regulations by the Romanian navigation companies and the ships in property or operated by these, as well as the ship control and checking, irrespective of the pavilion, that enter the Romanian ports.

Port and /or navigable ways administrations will put into execution the charges the Government is incumbent out of implementing the ISPS Code regulations, for the port facilities situated in their jurisdiction area, according to the Government Order nr. 22/1999, completed by the Law nr. 528/2002.

Consequently, the companies that manage a port facility are obliged to design a security plan, based on the risk analysis, approved by port Administration Constantza and on which basis the Port Authority delivers the Conformity Declaration. The port facility operators are obliged to settle their own security management systems for port facility where they carry on the activity on the basis of some security plans.

The port facilities have each selected a security officer, that concerns himself with implanting and maintaining a security management system. Annually, each port facility is put to a security assessment, examined and approved by the Port Administration, which is followed by an external audit of the system security. A specialized department of the Port Administration, consisted of 29 people supervise respecting the legal regulations in the three ports (Constantza, Midia and Agigea), which are in situated in jurisdiction of National Company of Maritime Ports Administration.

In order to increase the general security level in Constantza port an ultramodern and efficient security system is being implanted which will ensure the control of the people and the means of auto transport access in port.

The communication activity between the ship and port having a major role in raising the ship and port security, is performed by the National Company for Naval Radio-communications S.A. Constantza which may communicate with the ships, regardless of the pavilion, in all the frequents allocated to the mobile maritime service by the International Telecommunication Union.

The security level in Constantza Port is level 1, and it claims:

- assuring performing all security charges at ship;
- controlling access at ship;
- supervising the restricted areas, for assuring that only the authorized people have access;
- supervising the areas on deck and the areas surrounding the ship;
- supervising handling goods and ship supplies;
- assuring that the communication system regarding security is available.

At the security level 1 each ship is endowed with a security plan at board, approved by the port administration which comprises:

- Measures destined to hinder introducing to the ship board weapons, dangerous substances and equipment with the purpose of being used against people, ships or ports;
- Identify the restriction areas and measures for preventing the unauthorized access in these areas;
- Measures for preventing the unauthorized access into the ship;
- answer procedures to threats regarding security or attempts on security, inclusively regulations for maintaining the vital operations of the ship or the interface ship/port;
- Procedures for evacuation/quitting in case of threatening regarding security or attempts on security;
- The obligations of the staff on board charged with responsibilities regarding security also of other members of the staff on board concerning aspects regarding security;
- Procedures for drilling, exercises, training associated to the plan;
- Procedures for the periodical revising of the plan and for its actualization;
- Procedures for reporting security incidents;
- Identify the person appointed with ship security;
- Identify the person appointed with the company security, included the contact service 24 hours for details;
- Procedures for assuring the inspection, test, calibrating and maintaining the security equipment settled at board;
- Frequency of testing and calibrating the security equipment settled at board;
- Identify the places where points for activating the alarm system regarding ship security;
- Procedures, instructions and the handbook referring to using the alarm system regarding, included testing, activating, deactivating and canceling for limiting the false alarms.

The security measures for port facilities corresponding to security level 1 are the following:

- Assuring executing all security tasks of all port facilities;
- Control access to port facilities;
- Monitor port facilities, included landing area;
- Monitor the restricted areas to assure that only the authorized people have access;
- Supervise manipulating goods and ship supply;
- Assure that the security communication system is available.

5 IMPACT OF THE IMPLEMENTATION OF ISPS CODE

The implementation of the ISPS Code has got the purpose to eliminate the terrorist attacks on ships and ports security, which may have incommensurable consequences for people, environment, international trade and transport (traffic close, significant delay, loss), economic and financial costs (especially if they refer to strategic goods, as petrol or gas, or they take place in crowded ports).

But apply the ISPS Code may also have negative effects, among which [3]:

1. The significant enhance of the stationary time and of the ship passage cost through the port, due to :

the additional security measures at board and out at sea;
increasing load/unload time of ships;
delay at receiving loads, inspectors;
additional examinations performed by the pavilion state or by the port where the ship lands;
increasing the goods waiting time;
enhance the ship waiting time in ports;
increasing the time of documents linked procedures.

Increasing the costs of import and export products;
Greater costs for port users;
More commercial barriers.
Therefore, port operations are getting safer and safer but more slowly and more expensive.

CONCLUSIONS

The ISPS Code represents the most important initiative referring to the global security with impact on the international maritime transport. It was designed to ensure maximum protection from terrorist activity across ships and ports. The purpose of the code is to design a standardized scheme for risk assessing allowing the member states governments to diminish the vulnerability of ships and port facility by applying the security measurements corresponding to risk levels.

Containers move along network of nodes and links, through modes of transport, but container transport chain is not uniformly secure, and the risk of security at any one point can compromise the security of entire chain.

The application of Code ISPS provisions in Romania is compulsory and necessary to maintain Romanian ships and ports in world economic circuit and to avoid their registration on the black list of uncertain ships and ports.

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THE BEGINNINGS OF THE ROMAN FLEET, 509-264 B.C.

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Abstract: *By the starting years of the First Punic War, the attestations of the ancient literary tradition about the Rome's involvement in maritime affairs are on and off and lacking clarity. The first two Roman-Carthaginian treaties from 509 and 348 B.C. mention navigation bans for the Roman ships, however it is very likely for the two agreements to refer to the trading vessels. The year 311 B.C. records the official foundation of the Roman naval force by the establishment of a double naval magistracy, duumviri navels'. This bright start has not led to a remarkable development of the Roman fleet. A squadron of 20 ships sent by the Romans in the Ionian See was destroyed by the Taren tine fleet in 282 B.C. In 278 B.C., through the provisions of the forth Roman-Carthaginian treaty, it was set that Rome was to receive naval aid from its contrahent from the North Africa Coast. Entered into within the context of the war against Tarentum and the king Pyrrhus of Epirus, this agreement is a proof of the low development of the Roman military navy at the end of the 4th century B.C. and during the first decades of the following century.*

Keywords: *fleet, Roman.*

Before the battle of Actium in 31 B.C., Plutarch states that the legionaries had asked Antony to engage in the fight with Octavian on the land, addressing the following words to him: "Antony, leave the Egyptians and the Phoenicians fight on sea but give us the land that we use to stay, die or defeat the enemy on" [Plutarch, *Antonius* 64.3]. Anthony's choice to support the battle on sea turned out to be fatal, both for his fate and for that of the Roman Republic.

We have no certitude that these memorable words are real, but they reflect a reality that has kept on existing for centuries in the Romans' mentality. The Roman soldiers have never really loved the sea, and the most honorable service possible for the citizen was performed within the country's legions.

This attitude reflects also in the level of the information kept in the ancient literary tradition on the Roman maritime activities. For the Rome's Italic expansion stage, the written records are scarce, scattered at Polybius, Diodorus, Dionysius, Livy, Cassius Dio, Orosius or Zonaras.

They have all written centuries after the recorded events had occurred. This lays before the modern researcher a literary tradition that is blunted, inaccurate or contaminated through wrong information channels. Therefore, no suggested modern reconstruction can be expected to be more than a hypothesis.

The first data on the Roman vessels come from the Greek author Polybius. He preserved, in the pages of his *Histories*, the text of a first Roman-Carthaginian treaty that he dates in 509 B.C., the year when the republican regime began. The linguistic arguments plead for this chronological location as Polybius laments the very archaic Latin used in the agreement's text, a detail that makes us believe that the Greek author has found the treaty somewhere in the Roman archives [Polybius 3.22.3-4]. According to Polybius, the naval clauses of the treaty were written as follows: "The Romans and their allies not to sail beyond the Fair Promontory unless forced by storm or by enemies; it is forbidden to anyone carried beyond it by force to by or carry away anything beyond what is required for the repair of the ship or for sacrifice and he must depart within five days. Men coming to trade may conclude no business except in the presence of a herald or town-clerck, and the price of whatever is sold in the presence of such shall be secured to the vendor by state, if the sale takes place in Libya or Sardinia. If any Roman come to the Carthaginian province in Sicily, he shall enjoy equal rights with others" [Polybius 3.22.4-11]. In this wording, the agreement makes us think that the Carthaginian State has been the one that has imposed the navigation limits and conditions, a field he had a secular background in. In all probability, the clauses pertain to the Roman trading vessels and to those of the Rome's allies, without referring to military actions. The Roman navy's weak development or maybe even its inexistence stems from them but at the same time, the terms of the agreement from 509 B.C. represent the first record of the Roman or Latin traders in the commercial activities from the Occidental Mediterranean Sea [Scardigli 1991, p.63-66]. From another perspective, it is very interesting that the Roman State has publicly undertaken to protect and regulate their activities, reality which points out a certain mutually favorable connection between the public authority and those that were directing their boats to various areas of the Mediterranean Sea. Considering the fact that no clear distinction has ever been made in antiquity between piracy and trade, it may be inferred that the treaty also insured certain areas of interest for Carthage against theft and violence-based actions. In another train of thoughts, it appears that the Roman or Latin navigators were not strangers to this type of activity, and the Roman Republic has tacitly encouraged or tolerated it due to the obtained economic advantages.

More than 100 years have passed after 509 B.C. before a Roman maritime activity was mentioned again. We may blame this precarious situation on the opacity of the literary tradition that was not interested in the Rome's naval evolution. In the 5th century B.C. events that have captured the ancient authors' interest due to their dramatic character and meaning to the Roman power expansion have occurred in the Central Italy area. By the end of the 5th century B.C., Latium had undergone a real siege under the pressure from the Aequi and Volsci who were trying to penetrate the fertile field areas. The North border conflicts with the Etruscans added to this threat. Rome probably had to neglect the fleet and concentrate its efforts against the continental enemies due to the course of events.

In 394 B.C., the literary sources mention a vessel under Roman flag sailing towards Delphi in a religious mission. It carried a part of the capture from the conquest of the Etruscan city Veii that was to be given as tribute to God Appolo. Probably weakly equipped and with an inexperienced crew, the ship was captured by the pirates in the strait of Messina and taken to the Lipare Isles. The sacred mission of the Roman delegation has represented the rescue of the prisoners from the pirates. Learning about the vessel's destination, the pirates set it free and even provided its protection in the voyage to Delphi [Diodorus 14.93.3-4; Livy 5.25.7, 5.25.10, 5.28.2-4; Plutarch, *Camillus* 8, Appian, *Ital.* 8.1].

Another short record of the Romans' shy voyages on sea is reported around 378 B.C.. In Diodorus' *Historical Library* a Rome's tentative to found a colony in Sardinia is mentioned for this year [Diodorus 15.27.4; cf. Mitchell 1971, p.640, Scardigli 1991, p.64]. The fact that no mention is made in the following period on this transmarine colony makes us suppose that the 378 B.C. operation failed.

The years 349-348 B.C. record dramatic events for the Roman Republic's history and marks new diplomatic contacts. The great threat was outlined in Latium who faced a Gallic invasion. At the same time, in 349 B.C. the danger also threatened the coast of the Latin region. Livy records the hostile evolution of a Greek fleet along the Latium's coast and makes us believe that it was not just a simply pirates' act. [Livy 7.25.3-4, 7.25.12-13, 7.26.10-11, 7.26.13-15]. The fleet is very likely to have belonged to the former tyrant Dionysius the Young, banished from Syracuse in 356 B.C. In all probability, he was asked to intervene in the affairs of Central Italy by the Latin communities that prepared the revolt against Rome [Sordi 1960, p.153-165; Alföldi 1968, p.345-346, 407; Ferenczi 1968, p.210; Huss 1985, p.154-155]. Rome was unable to counter this attack on sea and concentrated on organizing a terrestrial forces device meant to prevent the disembarkation of the Greek troops on the Latin shore.

Aware that Rome could not cope with such a serious naval confrontation, the Roman Senate has tried to reintroduce the Carthaginian State in the diplomatic and political equation of the years 349-348 B.C.. Diodorus, Livy and Orosius mention an agreement between Rome and Carthage for the year 348 B.C. [Diodorus 16.69.1; Livy 7.27.2; Orosius 3.7.1], which may be synchronized with the second Roman-Carthaginian treaty from the series of those recorded by Polybius [Polybius 3.24.1-13]. It is possible that the negotiations have started one year before and maybe Rome, under the pressure of the Dionysius the Young's fleet, wished for an actual military alliance. After the Greek squadron has left the Latin waters, the military clauses made no meaning any longer and there had been reached a diplomatic formula that did not involve the mutual support of the contrahents. The text of the treaty and thus the naval clauses have also been preserved in the *Histories* of Polybius: "The Romans shall not maraud or trade or found a city on the farther side of Fair Promontory, Mastia, and Tarseum.

No Roman shall trade or found a city in Sardinia and Libya nor remain in a Sardinian or Libyan post longer than is required for taking in provisions or repairing his ship. If he be driven there by stress of weather, he shall depart within five days. In the Carthaginian province of Sicily and at Carthage he may do and sell anything that is permitted to a citizen" [Polybius 3.24.3-13]. This time the wordings "the Romans shall not maraud" and "the Romans shall not trade" precisely indicate the enforcement of the treaty for the trading vessels and those that were pirating the waters of the Mediterranean but had their operations bases in Rome or in the Latin harbours [Harris 1990, p.500-501, Scardigli 1991, p.105-108]. However, once again, there is no regulation for the Roman navy, which leaves us assume that this was in an insignificant state of development or it was simply not organized.

The importance of the fleet probably began to be perceived at Rome only in the last decades of the 4th century B.C. The examples from the past were warnings that deserved to be taken into consideration, and the expansion of the Roman influence towards the South showed the need of the navy, at least for an easier insurance of the communications [Adcock 1940, p.33]. In 338 B.C., after the submission of Antium, the warships of this community were transported in Rome [Livy 8.14.8]. In all probability, around them the Senate intended to pull round the Roman fleet. This evolution may be signaled quite clearly at the end of the 4th century B.C. From this development's perspective, the moment 311 B.C. may be considered the official year of birth of the Roman fleet. By means of a plebiscite a double naval magistracy has been instituted, *duumviri navales*, and the holders of the position were assigned to repair, maintain and lead the existent ships in Rome [Livy 9.30.4].

Certainly, the incipient Roman fleet was mainly organised as a means of communication with the troops that were operating in Campania in case of danger to the terrestrial roads [Beloch 1926, p.409, Thiel 1954, p.9]. The other objectives cannot be excluded either from our reconstruction. Only one year after the official institution, if we are to take into account a controversial testimony of Theophrastus, the Roman vessels have come into action. The Greek author mentions a Roman fleet made up of 25 ships that tried to settle a colony in Corsica [Theophrastus 5.8.2]. The event is not exactly dated, but we may assume that it took place sometime during the year 310 B.C., being a part of the maneuvers carried out in the Etruscan War begun in 311 B.C. [Nedu 2006, p.762-763].

The presence of the Roman vessels in the Campanian waters is attested for the year 310 B.C., in a combined operation. The crews debarked on the shore, but they were rejected by the troops sent from Nuceria. [Livy 9.38.2-3, Diodorus 19.65.7].

These records depict the picture of a navy in an incipient stage, without remarkable successes in its vents on sea. However, it is important that Rome had at its disposal 25 vessels at the end of the 4th century B.C., if we are to consider the fact that Rhodes, a state with great maritime skills, kept on water, during peace time, a fleet of 30 ships in order to prevent the piratical actions [Starr 1989, p.54].

Even the queen of the West Mediterranean, Carthage, kept an eye on Rome's first attempts to explore the way of the sea. In 306 B.C. the third Roman-Carthaginian treaty reserved Italy as an area exclusively of Roman interest, while Sicily became a territory subjected to the Carthaginian influence [Polybius 3.26.1-7; Livy 9.43.26]. Together with the mapping of the areas of interest, the agreement also established the neutral regime of Corsica [Servius *Ad. Aen.* 4.628]. This treaty answered to the new force relations from the area of the Occidental Mediterranean Sea, as Rome had become, at the end of the 4th century B.C., the greatest force in the Italic Peninsula. At the same time, though, we also have to perceive it as Carthage's preventive reaction when faced with the beginning of Rome's maritime adventure [Staveley 1959, p.422-423; Mitchell 1971, p.638-641; Scardigli 1991, p.144].

Another political act from the end of the 4th century B.C. shows connections with the incipient development of the Roman fleet. In 302 B.C., against some tensed relations, Rome and Tarentum arranged their scopes of interest in the Italic Peninsula. By means of the so called "Lacinian Treaty" Rome probably obtained the recognition of its allies in Apulia and the Sallentine region, but was forced in return not to navigate beyond the Lacinium Promontory, in Magna Graecia's waters where Tarentum had great interests [Appian, *Samn.* 7.1]. The Lacinian clause proves the existence of the Roman navy, the fact that it stirred worries at Tarentum, but the pact's interpretation must be done with precaution. Not nearly does it show Rome's transformation into a great naval power at the end of the 4th century B.C..

The continuation of the Second Samnitic War until 304 B.C., then the outbreak of the third war with the League from Samnium in 290 B.C., forced Rome to concentrate again its resources in the land war area. The promising beginning of 311 B.C. did not bring about, in these conditions, the path to a consistent and accelerated naval development.

In 282 B.C. a Roman fleet of 10 ships sailed in the Ionian Sea, probably to support the operations engaged by the legions in the region of the Greek city Thurii [Thiel 1954, p.25]. The attempt became a disaster for the Republic's naval forces. The Roman squadron was attacked by the Tarentine fleet, a vessel was destroyed and four more others were captured [Dionysius 19.4; Livy *per*.12; Florus 1.13.3-5; Appian, *Samn.* 7.1; Cassius Dio 9.39.4; Orosius 4.1.1; Zonaras 8.2]. It is difficult to say whether the ships were badly built, or the crews untrained or the command was uninspired, as long as the sources describe the incident in a lapidary manner. What surely follows is the fact that Rome was losing its first attested naval battle in its history and its fleet was unable to face the Greeks who had a solid and vast experience in the field of maritime warfare.

The fourth Roman-Carthaginian treaty, signed in 278 B.C., in the context of the occidental expedition of king Pyrrhus, clearly shows that Rome was aware of its own naval weakness and also realised that the military actions in Magna Graecia needed the support of a strong fleet. The naval terms of the new agreement concluded with the African State, as kept by Polybius, represent the expression of what was said above: "No matter which require help, the Carthaginians are to provide ships for transport and hostilities, but each part shall provide the pay for its own men. The Carthaginians, if necessary, shall come to the help of the Romans by sea too, but no one shall compel the crews to land against their will" [Polybius 3.25.4-5]. Rome needed the Carthaginian fleet with a view to block Pyrrhus' communications with Balkan Greece and to be able to make an efficient siege on Tarentum, on land as well as on sea [Mommsen 1987, p.237].

The Romans inability on sea was shortly after demonstrated in another incident that unfolded in the South extremity of Italy. While the Roman legions were attacking Tarentum, in 272 B.C., a Carthaginian fleet appeared in the harbour of the city [Livy *per*.14, 21.10.8; Cassius Dio 11.43.1; Orosius 4.3.1-2; Zonaras 8.6, 8.8]. Although the intervention clearly represented a violation of the treaty from 306 B.C., Rome was unable to react. The most natural answer, in such a situation, would have been sending a fleet to the Tarentine harbour. The literary sources do not mention however the participation of any Roman squadron in the incidents around the Greek city, and the explanations for this absence may be but two: either the Romans feared that their fleet would have the same fate as it did in 282 B.C., if it came to another forced action, or their naval forces were too few and too weakly endowed to be able to put their hope in them.

The incident however made the relations between Rome and Carthage even more tensed and it is very likely that of this moment the Senate had in mind the possibility of a conflict with the African State within the next period [Harris 1979, p.184]. The readying of the next war also intended the reorganisation of naval forces from the Italic harbours, because one could assume that the fleet would play an important role in a Roman-Carthaginian conflict. In 267 B.C., Rome considered it necessary to have an exact evidence of the ships that it could have at its disposal in case of crisis. Four *quaestores classici* were instituted, that year, with the headquarters in Ostia, Cales and Ariminum, with the mission to supervise the way in which the allies honoured their naval obligations provided in the treaties made with the Roman Republic [Livy *per*.15; cf. Thiel 1954, p.33].

Apart from the efforts to organise its own maritime forces, Rome depended on the naval support of the Italic allies. In this system the Greek cities certainly played the most important role. The first treaty signed with a Greek city from Italy was the one concluded with Naples, in 326 B.C. [Livy 8.26.6-7]. We do not know the clauses of the agreement, but one can assume that, in exchange of their autonomy, Naples undertook to supply Rome with warships when it was required [De Sanctis 1960, p.285-286]. The treaties that sanctioned the institution of the Roman control in Magna Graecia, concluded with Thurii, Locri, Croton, Heraklea, Tarentum or Rhegium included some naval terms [cf. Lomas 1993, p.56-57]. We deduct this reality from the participation of Greek ships in the Roman military activities from the following periods. In 264 B.C., when the Roman troops landed in Sicily, Naples, Velia, Locri and Tarentum supplied vessels [Polybius 1.20.13-14]. Paestum, Velia and Rhegium contributed with 12 ships in 210 B.C. [Livy 26.39.5]. In 195 B.C., the Greek allies participated with 5 vessels in the Roman war efforts [Livy 34.8.4]. In 191 B.C., the Greek forces participating in Rome's naval operations are recorded with a number of 24 vessels [Livy 36.42.1-2]. Around 171 B.C. we have from Livy a more exact record of Greek naval contributions: Rhegium supplied one ship, Locri two, and Thurii engaged with 4 [Livy 48.42.6].

Although the deficiencies of the literary tradition raise problems of interpretation and appreciation, the general lines of the Roman naval policy until the outbreak of the First Punic War can essentially be traced. The fleet was placed on a secondary level, if we are to compare it to the attention given to land forces. The Romans were aware of the dangers that could appear from the sea, as it happened, for instance in 349 B.C., but the solution to counter attack them was also a terrestrial one. After the Latin War from 340-338 B.C., Rome established, alongside the colonies with a Latin status, citizens colonies, *coloniae civium Romanorum*. Before the end of the Second Punic War, *coloniae civium Romanorum* were established especially on the coast, which won them the name of *coloniae maritimae*. In the middle of the 4th century B.C., such a settlement was established at Ostia, at the months of the Tiber [Salmon 1970, p.177-178, n.108]. In 338 B.C., the maritime colony from Antium was founded [Livy 8.14.8]. These two settlements were established in order to protect the coastal line which bordered *ager Romanus*, and thus not to need to maintain a fleet on water. In 329 B.C., the Roman colony from Tarracina was settled [Livy 8.21.11] and in 295 B.C. the pair of Roman colonies Miturnae - Sinuessa was established [Livy 10.21.8]. Their mission was to protect the Latin coast and to ensure communication with the dependant cities from the North of Campania. The inland route to Campania, which followed *via Latina,* on the course of the rivers Trerus and Liris, was risky due to the presence of the Samnites. The coastal route, *via Appia*, had to be protected from the sea, and the maritime colonies could fulfil this mission. Between 289-283 B.C., in the North-East area of Italy, Rome founded the colony with Roman status from Sena Gallica, that had to protect the Adriatic coasts of the peninsula against the raids of the Illyrians and against the attacks coming from the cisalpine region. [Polybius 2.19.13; Livy *per*.21]. The maritime colony of Castrum Novum was established exactly in 264 B.C., the year of the outbreak of the First Punic War [Livy *per.*11; cf. Salmon 1970, p. 70-79].

Normally such a settlement had a small number of people, of only 300 citizens. The Roman authorities did not afford the separation of a too large number of people from the civic corps of the city, because the colonists became exempt from service in the legion by a *sacrosancta vacatio militiae*. From a different perspective, the spread of the Roman citizens in different areas would have made impossible a centralized administration, specific to the institutions of a city-state. These small settlements were probably never too attractive to the Roman citizens. The colonists sent to the coast were not allowed to miss from the settlement for more than 30 days. They had to be alert all the time, to prevent the raids coming from the sea and to stop the building of pier heads on the shore [Thiel 1954, p.12; Salmon 1970, p.72-77].

This policy, initiated to secure the sea from the coast, could be operative in case of small raids. A maritime war considerably diminished however the role of the colonies from the shore and imposed the building of a fleet capable to wage naval battles and to secure maritime routes. The establishment of the maritime colonies proved efficient as long as Rome's policy was maintained within the limits of the Italic peninsula. When this barrier was crossed and when the operations in Sicily began, the absence of the war fleet was fully felt in Rome. Pushed by needs, the Romans launched to sea in 260 B.C. the first important fleet in their history. It also brought to Rome its first naval success in the battle of Mylae. However 250 years had to pass, full of hesitations and failures, until the Romans, in a moment of crisis and under the pressure of events, fully realised the importance of the navy. For a state with Mediterranean ambitions, the fleet had to become a first level priority.

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TEMPORARY-SPATIAL FILTERS WITH REMISSIVE NETWORK

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Abstract: *Using a simple lab template and two experimental electronically acoustic processors we demonstrated the transferring of source's position from the underwater environment in acoustic processor's plan on the correlation network. Better results could have been obtained by using acoustic waves on the surface. The results obtained confirm their efficiency in the underwater acoustic domain and the usage of the electronically acoustic processors now and in the future.*

Keywords: *filter, spatial, network.*

Spatial filtering in the sense of movement of the directivity characteristic null of a network type antenna in the parasite direction is a method for signals process. If the signal propagation domain is underwater domain and the field is acoustic, spatial filtering is an interactive method for processing, and the pies electrical materials, especially pies ceramics have a vast field of applications.

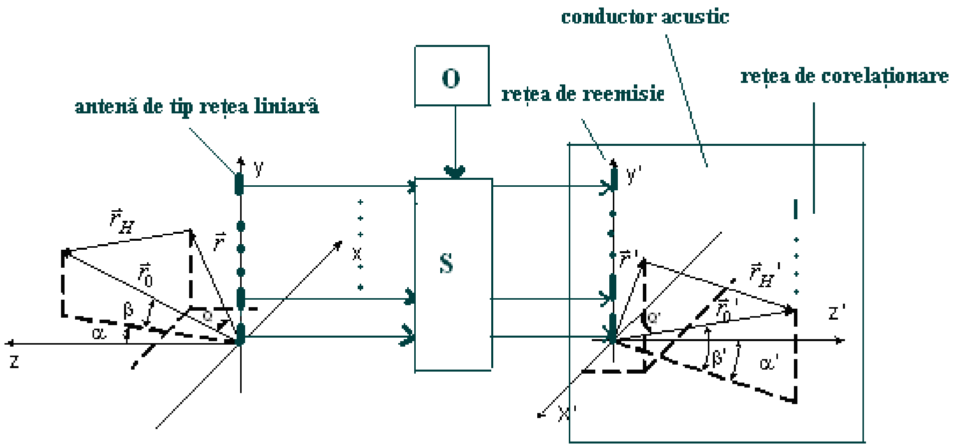


Fig.1

In fig.1 the linear type network antenna formed by n pies ceramic receives a signal of $z(t,\overline{r_o},\overline{r}) = s(t,\overline{r_o},\overline{r}) + n(t,\overline{r})$. We assume in the space point with the vector radius $\overline{r_o}$ the source δ, who is transmitting the $s_o(t,\overline{r_o})$. Trough δ we will understand that this source for which the complex amplitude of the oscillation in z=zo plan is equal with zero everywhere, besides the x=xo, y=yo point (the δ source notion is not identical with the point form source and it has been used as a physical abstraction). The receiving antenna is gave in the opening form function P in a common coordinating domain; $\overline{r}$ - the vector radius (position vector) of a common point from this domain. The antenna element in this moment is recording the audio signal mixture $s(t,\overline{r_o},\overline{r})$ and the $n(t,\overline{r})$ noise.

The signal is suffering a frequency change and it is applied to a reemission network situated in an acoustic conductor. The main parameter is the scale coefficient m=k/k', which is indicating the relative length of the wave from the acoustic device, reported to the underwater environment, the waves numbers from both environments. Troughs the speed difference and the wavelength between the two environments are done the focalization in length and in direction on the correlation network of the source from the underwater domain. We will further name the network reemission, acoustic conductor, network of correlation, electrono-acoustic processor. To put into effect the focus in distance and direction on the network of correlation of the source in underwater surroundings, have to demonstrate theoretically that the main function $W(k',\bar{r}'_0,\bar{r}')$, the distribution of the complex amplitudes of the received signals with the linear netting antenna, and $V(k,\bar{r}_0,\bar{r})$ the distribution of the complex amplitudes of signals on the remissive network, fits into the relation:

$$W(k',\bar{r}_0',\bar{r}') = V^*(k,\bar{r}_0,\bar{r})$$

Into the compact isotropic surroundings the distribution of complex amplitudes on the opening of the receiving antenna for the source δ, which emits o monochromatic signal, with a precision up to the amplitude factor, is described by the expression:

$$V(k,\bar{r}_0,\bar{r}) = \exp\left\{-jk\left[r\cos Q - \frac{r^2}{2r_0}\sin^2 Q - \frac{r^3}{2r_0^2}(\cos Q - \cos^3 Q) + \ldots\right.\right.$$

$$\left.\left.\ldots + \frac{r^p}{r_0^{p-1}}\sum_{q=E\left(\frac{p+1}{2}\right)}^{p}\frac{\left(\frac{3}{2}-1\right)\left(\frac{3}{2}-1\right)\ldots\left(\frac{3}{2}-q\right)}{q!}C_q^{2q-p}-(\cos Q)^{2q-p}+\ldots\right]\right\},$$

where Q – the angle made by the vectors $\bar{r}_0$ şi $\bar{r}$; E – the function "integer part of the number"; p = 1,2,3,…

The main function has the below format:

$$W'(x', x') = \exp\left\{ -jk'\left[x' \sin\alpha'_0 + \frac{x'^2}{2r'_0}\cos^2\alpha'_0 + \frac{(x')^3}{2(r'_0)^2}\sin\alpha'_0 \cos^2\alpha'_0 + \ldots \right]\right\}.$$

We fill in the angular scale coefficient $\mu = {}^{\sin\alpha'_0}\!/_{\sin\alpha_0}$. Keeping into consideration the biunivocal correspondence between RA elements of the receiving network:

$$W(x, x) = \exp\left\{ -j\frac{k}{m}\left[x\frac{D'}{D}\mu\sin\alpha_0 + \frac{x^2}{2r'_0}\left(\frac{D'}{D}\right)^2 \left(1 + \mu^2\sin^2\alpha_0\right) + \ldots \right]\right\},$$

where D' – the opening (turn on) of the remitting network for transducers; D' – the opening of the remissive network.

Comparing those two relations results, for the realization of the installation with the requested transmitting function is needed the same parameters $\mu = -1; D' = mD; r'_0 = mr_0$ and perform the operation of spectral conjugation on the signals frequency transformation.

For instance we made an electron-acoustic processor formed by adding together many elementary elements. One elementary element is made by: 2 numbered pies-electronic transducers stocked to a special glass acoustic conductor which represents the remissive network. By attaching two elements is raised a network of correlation.

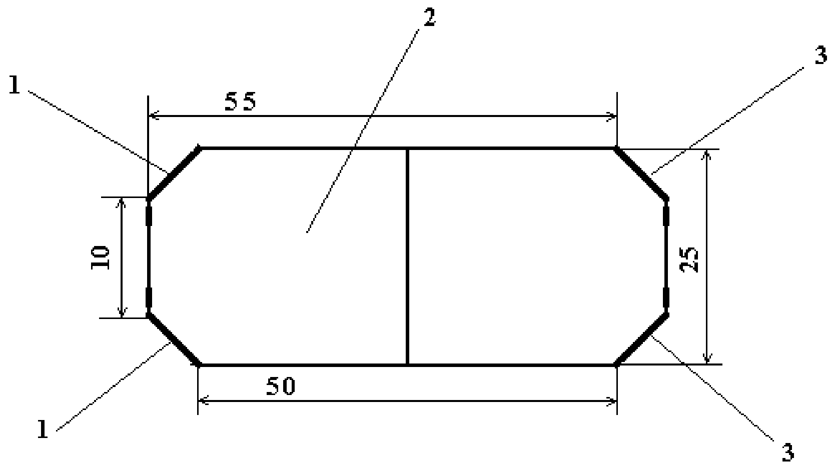


Fig.2

1. remissive network transducer;
2. special glass acoustic conductor;
3. correlation transducer.

The reckoning is made for the below values:

m = 0,5

$$k = \frac{2\pi \cdot 6 \cdot 10^3}{1450}$$

f = 6 kHz the frequency of the emitting signal from the source

c = 1450 m/s the sound speed through the underwater surroundings

r_0 = 1000 m – represents the wide from the source to the antenna
$\alpha_0 = 30^o$ – the angle made by the source with the antenna
We picked an antenna with a length of 100 meters.

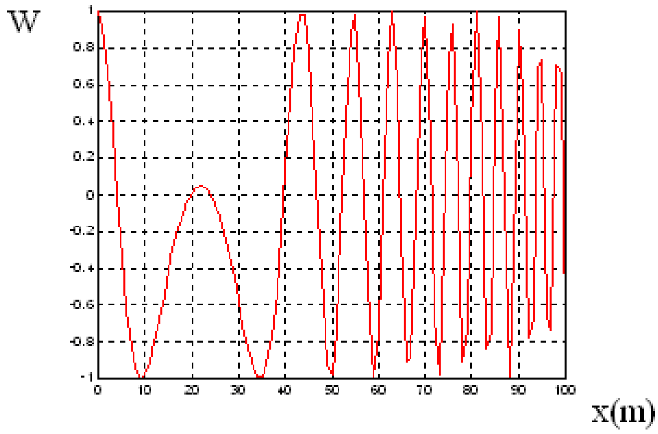


Fig.3 – the complex amplitude distribution on the receiving linear antenna

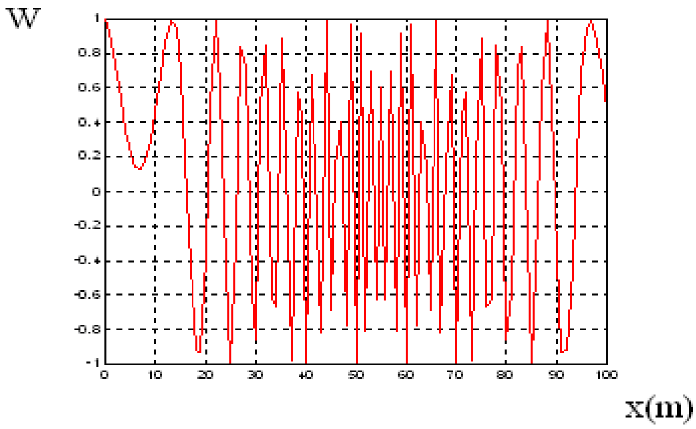


Fig.4- the reference function for the electrono-acoustic processor

It is obvious that the reference function creates the complex distribution function on a linear antenna for x=0÷50 in conformity with m=0.5

For the same k, r_o, $\acute{\alpha}_o$ but m=0.01, the figures are:

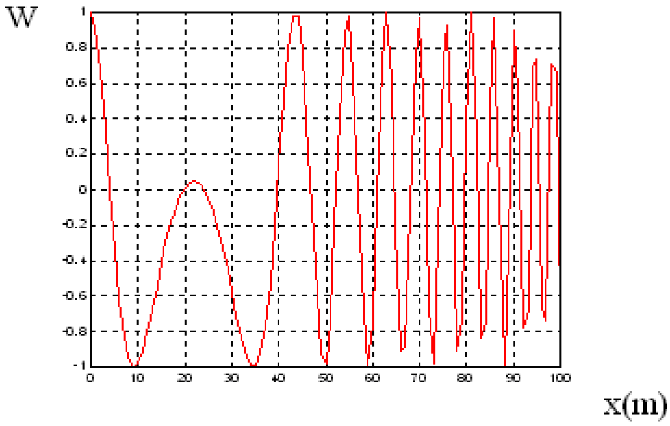


Fig.5-the complex amplitude distribution on the receiving linear antenna

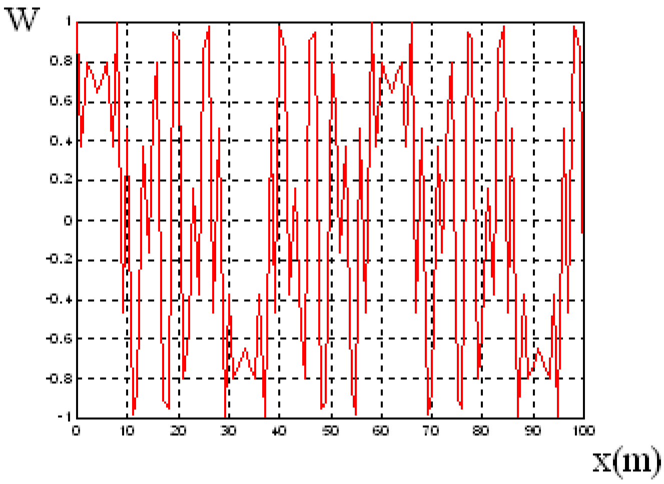


Fig.6- the reference function of the processor

For f=4,43kHz in sea ambience and f=4,43MHz in the acoustic conductor results a frequency scalar factor of m=0,001. For the same data as upon results:

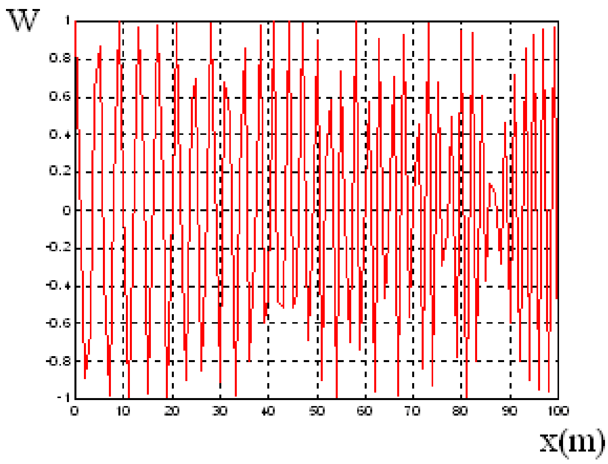


Fig.7 The complex amplitudes distribution function on the receptor antenna network α_0=15^0.

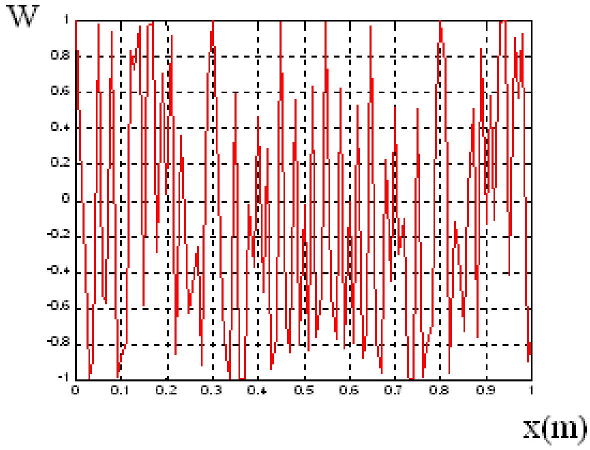


*Fig.8 The referent function of electronically acoustic processo*r

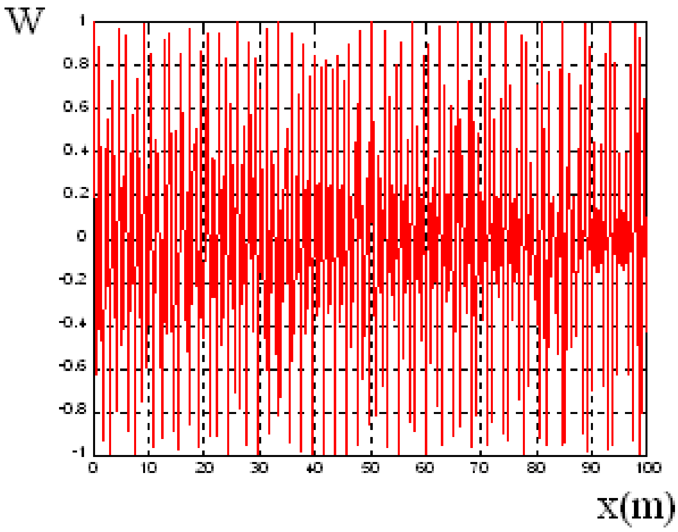


Fig.9 The complex amplitudes distribution function on the receptor antenna network α_0=30^0

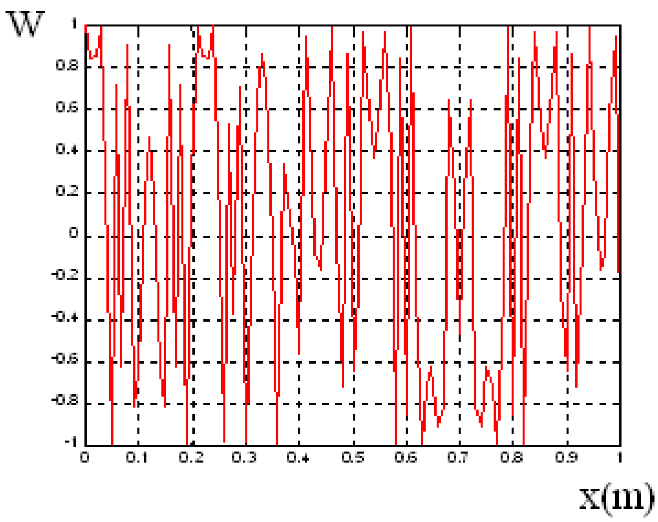
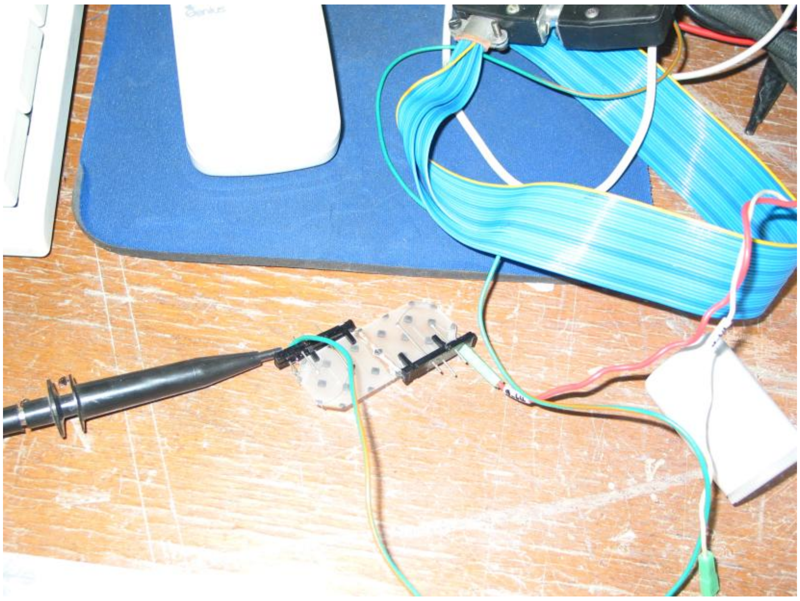


Fig.10 The reference function of the electronically acoustic processor

Considering this last case α0=300, m=0,001, r0=1000m by frequency scaling at an opening range of 100m for the linear network, results an opening range of 10cm for the remissive network. The calculated values for the w2 function represent the reference function of the electronically acoustic processor, for 1cm. The real part for x=0, w2(0)=1, x=1, w2(1)=-0,5612, the proper delays are w3(0)=0, w3(1)=206ms. Results U1=200mV, tension applied on transducer 1, as reference values, U2=112mV, tension applied on transducer 2, with a 206ms delay. The collected signals at the processor's exit are U1=38mV and U2=20mV, for an angle selection α0=400. The selection has a 100 error in angle and in distance we can't focus unless the signal's frequency is modified. Therefore the using of two transducers for the remissive network is too scant.

In the picture bellow we have the electronically acoustic processor



According to these observations we realized a processor with five piezoelectric remissive transducers and five piezoelectric transducers for the correlation network stacked on a thin plaque of aluminum, the excitement being made with the transversals waves.

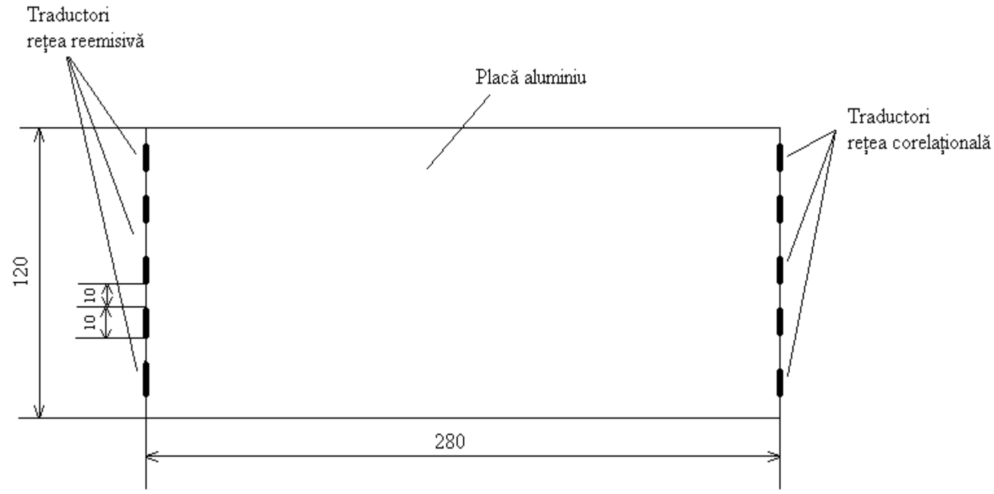


Fig.11

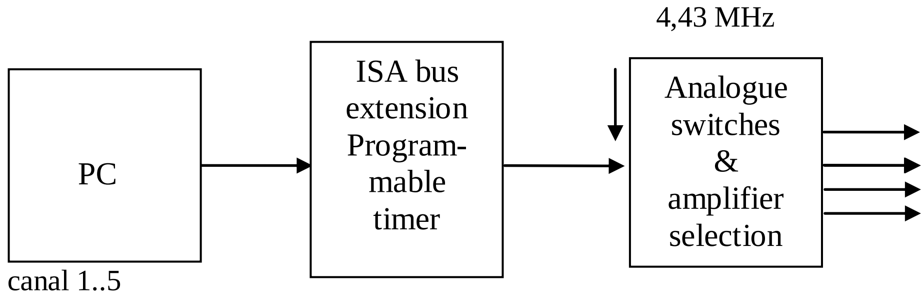


Fig.12

For the electronically acoustic processor made from aluminum plaque there was recalculated the reference function for 100 values of x, with the maxim value of 10cm, values which correspond with this processor's dimensions.

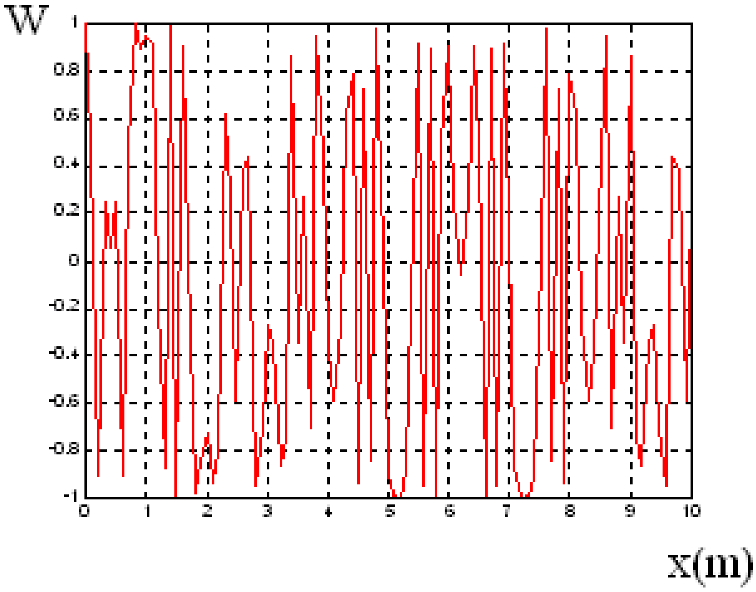


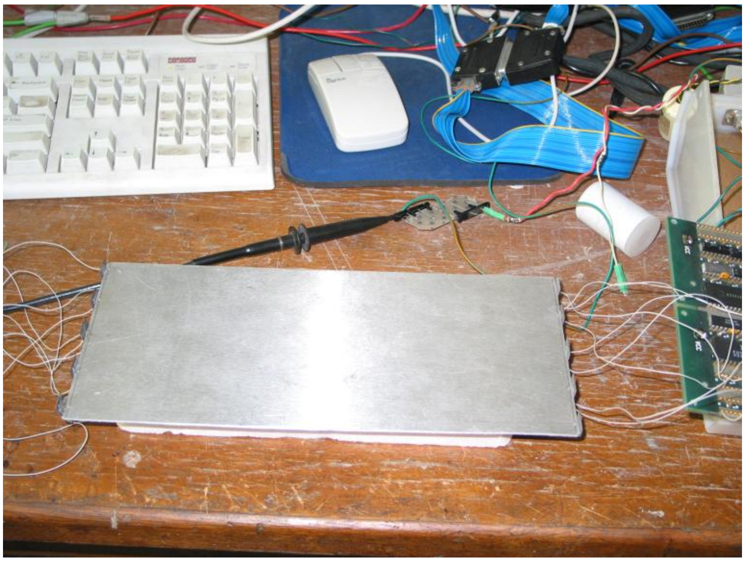
Fig.13 The reference function of the electronically acoustic processor

There have been calculated the values for the reference function w2 and the delays w3 for x=0. From the tables upon we take the entree tension in the transducers for the reference tensions of 200mV. Results U1=180 mV, U2=52 mV, U3=188 mV, U4=194 mV and U5=188 mV according to the table values: 0,907, 0,267, 0,947, 0,9766, -0,947. the according delays are 0, 206, 412, 618, 824, ms. We obtain at the outgo the next values: U1=1,9 mV, U2=1,6mV, U3=1.69mV U4=1,4 mV, U5=1,2mV according to the correlation network transducers. For the plaque's dimensions the angle selection α0=300 means a maximum outgo tension of the correlation transducer 1, that is obtained.

The other values decrees, but U3 > U2, the cause being given by the in homogeneities in the aluminum plaque, which creates an uncontrolled dispersion. But we can conclude: the selection in angle and distance is realized. If we modify the frequency we can obtain a better selection in angle and distance. The big attenuations for the first and second processors are caused by the gluing of the piezoelectric transducers on the acoustic conductor. The check-up has been realized with a laboratory template (fig13).

The delays are introduced in the program by an ISA extension (internal bus of PC) are programmed the counters and the analogical switchers. The electronically scheme for the ISA extension programmable counters and analogical switchers are specified in the Appendix 1 and the program in the Appendix 2. The ISA extension is realized with the bidirectional buffer 74 LS 245 on 8 bit, the sense of the transfer being indicated by the DIR pin, which is positioned on the first logical bit of the ISA bus. The address is 300H (free address in PC memory dedicated to „prototypes"). The programmable counters 82 C 54 are set in monostable regime, three triggers for circuit. One of the U4 circuit is set on clock regime. The analogical switches 4066 or LF 11332 provide the commutation with a delay of ns, more than enough for the present application. The program is written in Borland C, the delays are easily introduced, and the application can be extended for more channels. The amplification selection or better said the signal's level is realized by the amplifying command of the LF147 circuits using the LF1033 switches.

In the image bellow is presented the electronically acoustic processor.



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THE MATHEMATICAL MODEL AND DATA ACQUISITION OF AN UNDERWATER EXPLOSION

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Abstract: *This report presents the triangulation of the underwater explosion source. The analysis is based on the time-delay measurement the underwater acoustic wave, deriving the range and the direction to the underwater source of explosion. The mathematical model is simulated for different values of the time-delay at three sensors. It was built a practical demonstrator, which gave the possibility to verify in real environment the mathematical model.*

Keywords: *model, underwater, explosion.*

1 INTRODUCTION

The hydro-acoustic sensors are placed in the A, B, C points, at d_0 range; the event takes place in O point. We trace a perpendicular in P point.

The wave will cover the range FB in the time T_B, which is $T_B = t_2 - t_1$, where t_2 is the time when the wave came in the B point, so $FB = T_B \cdot v$, where v is the speed of wave in the water, speed known either from the hydro-acoustic prognosis or approximated at 1450m/s.

The wave will cover the range EC in the time T_C, which is $T_C = t_3 - t_1$, where t_3.

Is the time when the wave came in the point C, so $EC = T_C \cdot v$.

We can write the following relations:

$$(OP)^2 = (OA)^2 - (PA)^2 \quad (OP)^2 = (OF + FB)^2 - (AB + PA)^2, \qquad (1)$$

$$(OP)^2 = (OE + EC)^2 - (AB + BC + PA)^2. \qquad (2)$$

The unknown of the system are: OP, OA, PA.

Knowing the sides, in OPA triangle, $\sin A = OP / OA$.

So the range and the direction are determinates. We observe that if the event is in the left of the hydro-acoustic sensors line, the wave came firstly in point C. In this case:

$$(OP)^2 = (OC)^2 - (PC)^2, \qquad (3)$$

$$(OP)^2 = (OF + FB)^2 - (CB + PC)^2, \qquad (4)$$

$$(OP)^2 = (OE + EC)^2 - (CB + BC + PC)^2, \qquad (5)$$

The unknown of the system are: OP, OC, PC.
Knowing the sides, in OPC triangle, $\sin C = OP / OC$.
Result PA:

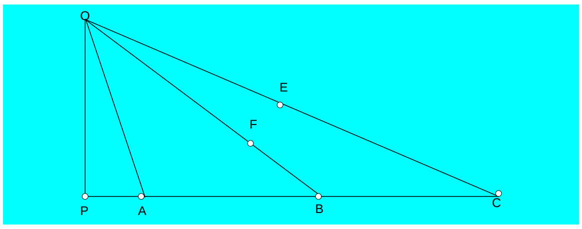


Fig. 1 The wave model

$$PA = \frac{(FB)^2 + 2 \cdot OA \cdot FB - (AB)^2}{2 \cdot AB}, \tag{6}$$

$$OA = \frac{2 \cdot (FB)^2 + 2 \cdot (AB)^2 - (EC)^2}{2 \cdot EC - 4 \cdot FB}, \tag{7}$$

Where AB is the range between the sensors, $AB = T_B \cdot v$, $EC = T_C \cdot v$, with $T_B = t_2 - t_1$ and $T_C = t_3 - t_1$, t_1 is the time when the signal was received by the sensor from the A point, t_2 is the time when the wave came in the B point, t_3 is the time when the wave came in the C point. The results of the simulation are presented down. The source programs are given in the table 1

Table 1. The simulation results

INITIAL DATA TRIANGULATION PROGRAM

No.	x	y	z	v	d	t0	t1	t2	t1-t0	t2-t0
Event at the left										
1	20	-24	31.241	1400	2	0.022315	0.02343	0.024578	0.001115	0.002263
2	35	-30	46.0977	1400	2	0.032927	0.033874	0.034854	0.000947	0.001927
3	60	-41	72.6705	1400	2	0.051907	0.052727	0.053571	0.000819	0.001664
4	95	-52	108.301	1400	2	0.077358	0.078053	0.078769	0.000696	0.001412
5	450	-132	468.961	1400	2	0.334972	0.335377	0.335787	0.000405	0.000815
6	1200	-450	1281.6	1400	5	0.915429	0.916689	0.917961	0.00126	0.002532
7	2400	-870	2552.82	1400	5	1.823444	1.824664	1.825891	0.00122	0.002447
8	5000	-2400	5546.17	1400	5	3.96155	3.963097	3.964646	0.001547	0.003096
9	12400	-6000	13775.3	1400	10	9.839529	9.842642	9.845759	0.003113	0.006231
10	25000	-12000	27730.8	1400	10	19.80775	19.81084	19.81394	0.003092	0.006186
Event at the right										
11	20	24	31.241	1400	2	0.022315	0.021237	0.020203	0.001034	0.002112
12	35	30	46.0977	1400	2	0.032927	0.032016	0.031143	0.000872	0.001784
13	60	41	72.6705	1400	2	0.051907	0.051115	0.050351	0.000764	0.001557
14	95	52	108.301	1400	2	0.077358	0.076682	0.076027	0.000655	0.001331
15	450	132	468.961	1400	2	0.334972	0.334573	0.334179	0.000394	0.000793
16	1200	450	1281.6	1400	5	0.915429	0.914181	0.912945	0.001236	0.002484
17	2400	870	2552.82	1400	5	1.823444	1.82223	1.821022	0.001208	0.002422
18	5000	2400	5546.17	1400	5	3.96155	3.960006	3.958464	0.001542	0.003086
19	12400	6000	13775.3	1400	10	9.839529	9.83642	9.833315	0.003105	0.006214
20	25000	12000	27730.8	1400	10	19.80775	19.80466	19.80157	0.003088	0.006178
									t2-t1	t2-t0

2 THE COMPOSITION OF THE DEMONSTRATOR

2.1 The underwater module

The underwater unit is realized in the following composition:

1 **The hydro-acoustic module**, containing a number of three identical subassemblies

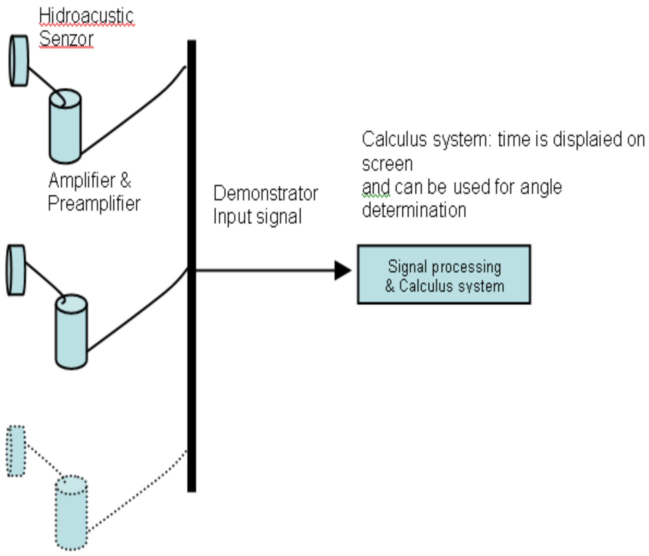


Fig. 2 The demonstrator

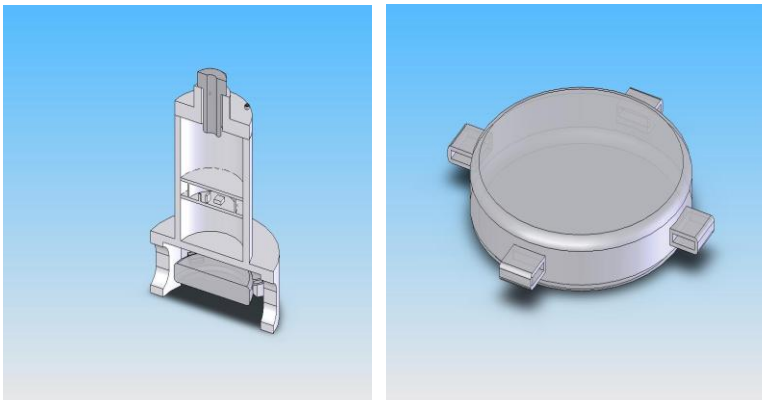


Fig. 3 The hydro acoustic module

2 **The concentration data and serial transmission module**

This module contains three serial cards and one command card. The connection between hydro-acoustic modules and the concentration data module is realized through a submarine special cable which assures the transmission of energy supply from the concentration data module to the sensors and of the received signal by the sensors to the concentration and serialization transmission module.

The general structure of the piezo-ceramic low frequency hydro-acoustic transducer (flex tensional) with symmetric circular section is presented in figure nr. 3. The low frequency hydro-acoustic transducer (flex tensional) is realized in the following structure:

1 – The body of the transducer, made by a case from dielectric material which allows the assemblage of the bimorph elements and of the electrodes, adequate connected. The piezo-ceramic element is realized from a composition of zirconium oxides, titan and lead, as basic elements, obtained by pressing and synthesize. The element is polarized at 30 kV c.c./cm voltage.

2 – The bimorph element, made by two piezoelectric discs of circular section, of high frequency, mechanic joined; the flex tensional transducer includes two bimorph transducers;

3 – The join electrodes, which assure the electric connection of the bimorph elements with the electric circuit;

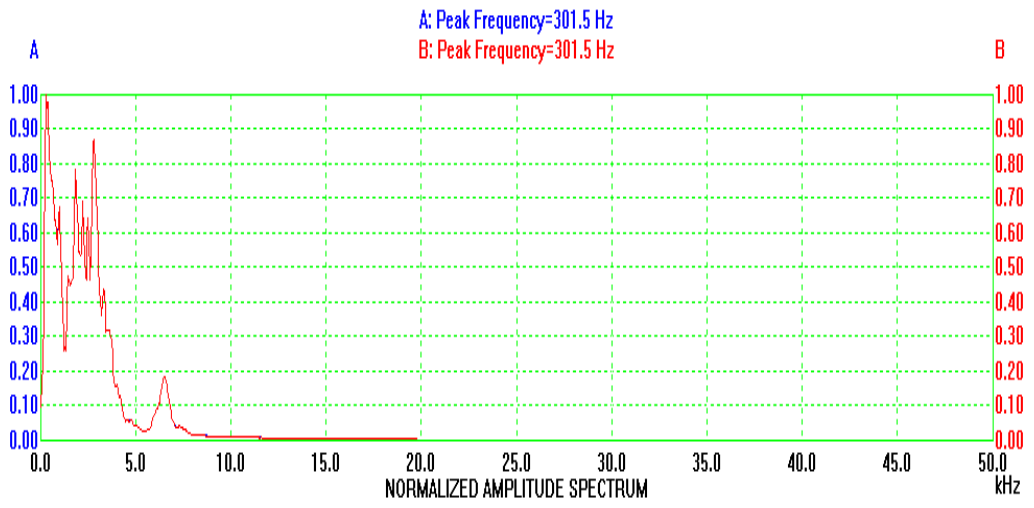
4 – The external connection band.

3 The low frequency amplifier

The low level signal in the passing band of the hydro-acoustic sensor is amplified in an adequate amplifier physical realized on a structure of two electronic modules joined between, as a sandwich.

4 The digitizing and serializing card

The data from the three hydro-acoustic modules are transmitted as an analogical signal to the concentration and serializing module. This module contains three serializing data cards and a command and control card.



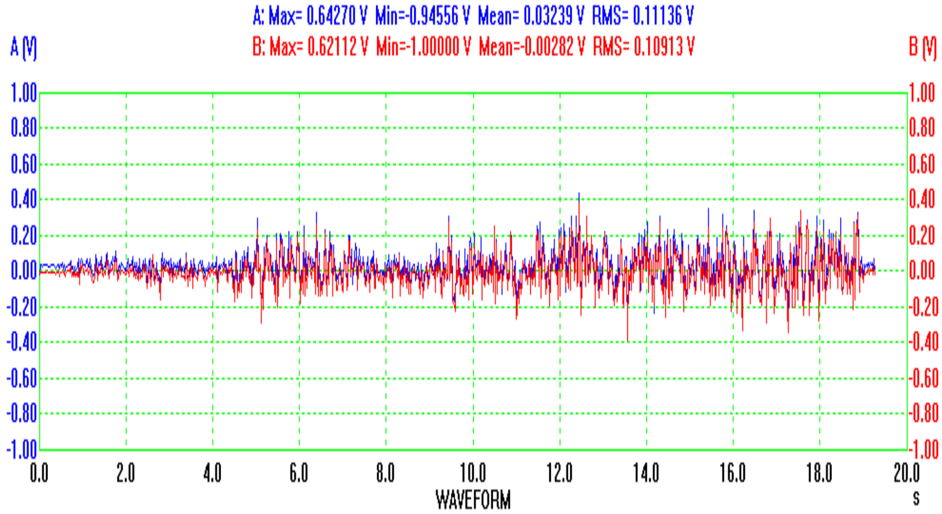


Fig. 4 The recorders from the experiment

The command and control orders are received from an adequate card which orders all the electronic conversion and serializing modules.

Specific is the fact that the serial data from the card are introduced at the IDATA entrance of the other card, so at the entrance in line it will be only a data source, but which came from three hydro-acoustic sensors.

2.2 The serializing command and control card

The digitizing and serializing card command and control orders are received from the command and control card by the transmission of adequate signals presented in figure nr. 7. The role of this card is to produce the command signals at the proper moment, which should assure:

- The synchronize and reset of the CAN;
- The command of loading the data from the CAN in the parallel-series registers;
- The clock the parallel-series moving.

The experiment was verified in the basin of the Naval Academy from Constanta (Romania). Experimental recorders have presented in figure 4.

3 CONCLUSIONS

1. In all records it appears a fundamental of low frequency at 300 Hz.
2. The wave form presents two maximum amplitude areas created by the sensors saturation.

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WAVELETS AND IMAGE COMPRESSION

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Abstract: *The main objective of image and video compression algorithms is to compress the image or video data into a compressed representation with constraints imposed by channel bandwidth and storage overhead while maintaining the highest possible quality. The field of image compression is based on a solid foundation of classical methods of transform coding vector quantization and recent advances of wavelet theory. With the advent of ubiquitous internet technologies and multimedia applications new research is needed to invent compression algorithms that meet the challenges of network demands bit rate, image quality and transmission delays for real time performance. This paper tries to introduce new image compressing techniques and algorithms because there is no lossy compression method being in the mean time universal and perfect in all possible applications, and therefore there is no unique performances evaluation criterion. The motivation of this is sustained by the necessity of using compression/decompression software structures with wavelet transform algorithms.*

Keywords: *compression, wavelet, image.*

1 INTRODUCTION

Video and image signal processing domain has a real progress and remains a very interesting area for research.

Rapid development of communications technologies upon last years made possible large scale introduction of digital processing techniques, next to many industrial applications, such as audio and voice signal processing, radar, sonar, seismic signal processing, biomedicine, but also image processing.

We meet image compression applications mainly in information transmission and recording. Being about photos, graphics, or animated figures or video, image is with text and sound, the main component of any modern communication system.

On the other side of the balance stand, and are pretty heavy, the costs, the technical problems for storing and manipulating them with computer, and, not at the last, the fact that their interpretation is often subjective.

The main reason of using signal compression for wavelet transform is applying of input signal transformation so that the most of its energy will be distributed in a restricted number of coefficients.

Image compression is necessary, and that's why developing fast algorithms is always a challenge, so that we can adapt to "omnipresent processing" situations.

Wavelet functions domain offers an edification theory for signals multi resolution representations, but also for decomposition filters design.

All of these concepts realize a minimal theoretical base for image compression and they are imposed by the necessity of as fast communication as possible, by using frequency ranges more efficiently, or by "occupying" the least space possible for image data storing (memorizing).

Study and research pointing on obtaining new methods for improving image compression using wavelet functions are an answer to limitations of using Discrete Cosine Transform (DCT), Discrete Sine Transform (DST) and Fast Fourier Transform (FFT) in image compression processes [1,3].

The main advantage of image compression methods based on wavelets, in opposite with methods based on DCT, DST or FFT, is the increase calculation speed.

2 IMAGE COMPRESSION IMPROVEMENT METHODS USING WAVELET FUNCTIONS

A wavelet functions base set can generate a transformation even if the functions are not orthogonal. This means that decomposition in wavelet series can represent a band function limited by an infinity of coefficients [2].

Classes of functions that can be represented through wavelet transforms are those which are square integrated in real space (2.1) and are noted L2(R).

$$\int_{-\infty}^{\infty} |f(x)|^2 dx < \infty \quad . \tag{2.1}$$

In wavelet analysis, it is generated a base functions set through dilatation and translation of an unique prototype function, $\psi(x)$, which is called wavelet base function. This function, which usually has the center in origin, decreases rapidly towards zero when $|x| \to \infty$, so $\psi(x) \in$ L2(R).

If $\psi(x)$ is a real function which Fourier transform, $\Psi(s)$ satisfies the admissibility criterion:

$$\mathbf{C}_\Psi = \int_{-\infty}^{\infty} \frac{|\Psi(s)|^2}{|s|} \mathbf{d}s < \infty, \tag{2.2}$$

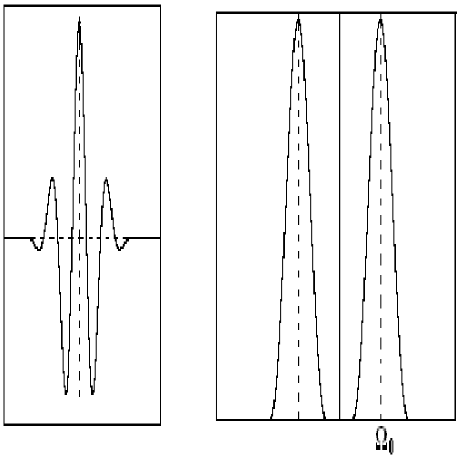
then $\psi(x)$ is called *wavelet base function* which, by its translation, will generate a base functions set $\{\psi_{a,b}(x)\}$ like:

$$\psi_{a,b}(x) = \frac{1}{\sqrt{a}} \psi\left(\frac{x-b}{a}\right). \tag{2.3}$$

Continuous wavelet transform of *f(x)* function, having as base function $\psi(x)$, is given by:

$$W_f(a,b) = < f, \psi_{a,b} > = \int_{-\infty}^{\infty} f(x)\psi_{a,b}(x)dx. \qquad (2.4)$$

Including parameter *a*, it determines a decreasing or an increasing of analysis window, so that the oscillations number in this window remains constant. A typical wavelet function and the associated transform are shown in figure 2.1.



(a) (b)

Fig. 2.1: Wavelet function and the associated transformation:
a) function $\psi(x)$, (b) frequency representation of $\psi(x)$

Wavelet Inverse continuous transform is:

$$f(x) = \frac{1}{\mathbf{C}_\psi} \int_0^{\infty} \int_{-\infty}^{\infty} W_f(a,b)\psi_{a,b}(x)db\frac{da}{a^2} \qquad (2.5)$$

We can observe that CWT transformation is not anything else than the convolution of f(x) with a wave function (wavelet), which is supposed to be well localized in time and frequency.

In figure 2.2 is represented wavelet continuous transformation like a linear filters bank (convolution), in two dimensional case, having at the input the function f(x,y). Each value of a defines another pass band filter, and the outputs of all filters, summarized, make the wavelet transformation.

In figure 2.3 is illustrated the dyadic transformation implementation with filters banks.

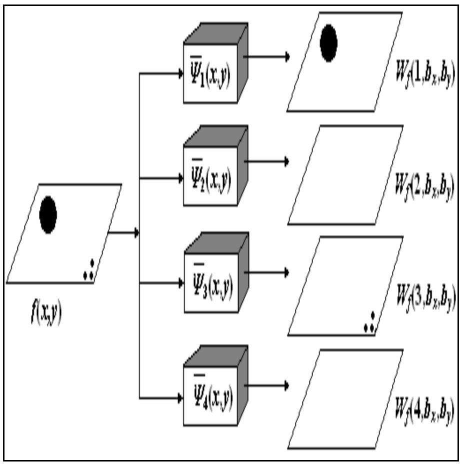


Fig. 2.2: Filters bank analogy for two dimensional wavelet continuous transformation

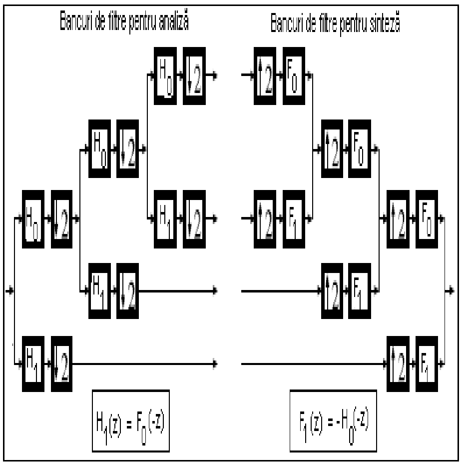


Fig. 2.3: Dyadic transformation implementation with filters banks

Using transformation *z* analysis, we can write the following statements for filters:

$$\begin{cases} H_0(z)F_0(z) - H_0(-z)F_0(-z) = 2z^{-(2L+1)} \\ H_1(z) = F_0(-z), \quad F_1(z) = -H_0(-z) \end{cases} \tag{2.6}$$

The parameters usually used for quantifying errors between images are: mean square error (MSE) and peak signal to noise ratio (PSNR), defined by relations (2.7) and (2.8):

$$MSE = \frac{1}{N}\sum_{j,k}\left(f[j,k] - g[j,k]\right)^2, \tag{2.7}$$

$$\mathbf{PSNR} = 10\lg\left(\frac{255^2}{MSE}\right). \tag{2.8}$$

3 IMAGE COMPRESSION APPLICATIONS

Four lossy compression algorithms are conceived and elaborated in an original manner, based on wavelet transform: plane bit encoding, EZW algorithm (Embedded Zerotree Wavelet), SPIHT algorithm (Set Partitioning In Hierarchical Trees) and WDR algorithm (Wavelet Difference Reduction) [4,5,6].

We presents the pseudo code which represents the starting point in plane bit encoding algorithm elaboration:

Step 1: *Initialize*. Choose initial threshold, $T = T0$, such that *all* transform values satisfy $|w(m)| < T0$ and at least one transform value satisfies $|w(m)| \geq T0/2$.

Step 2: *Update threshold*. Let $Tk = Tk-1/2$.

Step 3: *Significance pass*. Scan through insignificant values using baseline algorithm scan order. Test each value *w(m)* as follows:

If $|w(m)| \geq Tk$, then
Output sign of w(m)
Set $wQ(m) = Tk$
Else if $|w(m)| < Tk$ then
Let wQ(m) retain its initial value of 0 .

Step 4: *Refinement pass*. Scan through significant values found with higher threshold values *Tj* , for $j < k$ (if $k = 1$ skip this step). For each significant value *w(m)*, do the following:

If $|w(m)| \in [wQ(m), wQ(m) + Tk)$, then
Output bit 0
Else if $|w(m)| \in [wQ(m) + Tk, wQ(m) + 2Tk)$, then
Output bit 1
Replace value of wQ(m) by $wQ(m) + Tk$.

Step 5: *Loop*. Repeat steps 2 through 4.

For each algorithm of that presented above, the steps 1, 2, 4 and 5 are common, and the pass 3 (significant pass), is different from one to another. For these algorithms, but also for their implementation in software compression applications, there were elaborated programs in Matlab 6.5 medium. The software applications use for compression a large image variety.

3.1 WDR Algorithm

The term *difference reduction* refers to the way in which WDR encodes the locations of significant wavelet transform values, which we describe below. Although WDR will not typically produce higher PSNR (Peak Signal to Noise Ratio) values than SPIHT (Set Partitioning in Hierarchical Trees), we will see that WDR can produce perceptually superior images, especially at high compression ratios. The only difference between WDR and the bit-plane encoding is in the significance pass. In WDR, the output from the significance pass consists of the signs of significant values along with sequences of bits which concisely describe the precise locations of significant values [7,8,9].

The embedding process used by WDR Algorithm is called *wavelet differences reduction*.

For one thing, WDR does not need to search through quadtrees as SPIHT does. The calculation of the reduced binary expansions adds some complexity to WDR, but they can be done rapidly with bit-shift operations. The output of the WDR encoding can be arithmetically compressed. This form of arithmetic coding is substantially less complex (at the price of poorer performance) than the arithmetic coding employed by SPIHT.

3.2 Experimental Results

We created some programs in Matlab 6.5 to compress images using WDR algorithm, beginning from the five steps algorithm presented above.

For to obtain the results presented in table 3.1 and 3.2 we used a Intel P4, 3.4 GHz, 2048 MB DDR.

Fig. 3.1: The original image and results after 3 items

Table 3.1: Numeric example

Items nr.	MSE	PSNR	Compression's rate	Time[s]
1	6415.12	10.05	386.4:1	18
2	1199.36	17.34	138.4:1	47
3	381.30	22.31	75.52:1	61
6	5.61	40.63	22.16:1	158
7	1.44	46.54	16.8:1	195

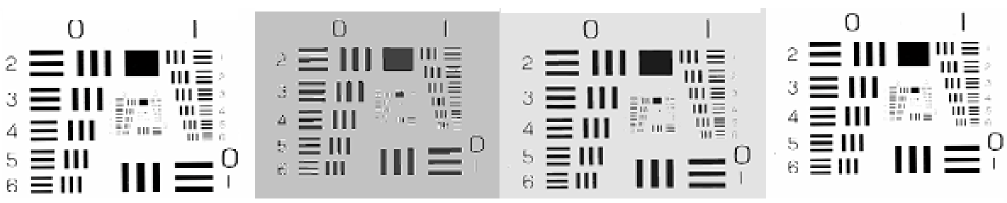


Fig. 3.2: The original image and results after 3 items

Table 3.2: Numeric example

Items nr.	MSE	PSNR	Compression's rate	Time[s]
1	14006.72	6.66	225.6:1	10
2	3445.80	12.75	109.6:1	14
3	838.50	18.89	71.84:1	18
6	8.75	38.70	33.04:1	30
7	1.15	47.51	27.52:1	34

4 CONCLUSIONS

In this paper the author is introducing new image compression techniques and algorithms because there is no universal lossy compression method for every possible application, and no unique criteria for performance evaluation.

Lossy compression techniques have very high compression rates opposite with lossless techniques, but with the price of loosing graphical information, meaning relative decreasing of obtained image quality. Usually these algorithms must be conceived taking in consideration the limits of human visual system for an imperceptible depreciate resulting image.

The use of a very small alphabet to represent an image (maximum number of four symbols) makes adaptive arithmetic coding very efficient, because it adapts itself very quickly to any changes in the statistics of the symbols. Since the maximum distortion level of a coefficient at any stage is bounded by the current yardstick length, the average distortion level in each pass is also given by the current yardstick, being the same for all bands.

At any given pass, only the coefficients with magnitudes larger than the current yardstick length are encoded nonzero. Therefore, the coefficients with higher magnitudes tend to be encoded before the ones with smaller magnitudes. This implies that the WDR algorithm tends to give priority to the most important information in the encoding process.

Since the WDR algorithm employs a successive approximation process, the addition of a new symbol, to the string just further refines the reconstructed image. Furthermore, while each symbol is being added to the string it is encoded into the bit stream; hence the encoding and decoding can stop at any point, and an image with a level of refinement corresponding to the symbols encoded/decoded so far can be recovered.

Therefore, the encoding and decoding of an image can stop when the bit rate budget is exhausted, which makes possible an extremely precise bit rate control. In addition, due to the prioritization of the more important information no matter where in the bit stream the decoding is stopped, the best possible image quality for that bit rate is achieved.

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BOOTLOADER SOLUTION FOR XILINX EDK APPLICATIONS ON DIGILENT NEXYS BOARD

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Abstract: *The Digilent Nexys board represents an excellent low-cost solution both for education and research purposes targeting FPGA-based applications The Spartan-3 device featured on the board allows building embedded systems on a Microblaze soft-core processor. This paper presents a memory controller and bootloader solution for the Nexys board memories that allows running embedded software applications above the FPGA Block-RAM (BRAM) memory size. The software is programmed into the Nexys FLASH memory using manual steps. Then a bootloader application from Xilinx is used to load and execute the application stored in the external memory. Aspects regarding memory usage efficiency and code segmentation issues are discussed and further developments are presented.*

Keywords: *bootloader, Xilinx EDC*

1 INTRODUCTION

The Digilent Nexys board represents an excellent low-cost solution for developing applications on FPGA, both for education and research purposes. Chapter 2 presents the most important characteristics and indicates target usage for various peripherals regarding design complexity. The Spartan-3 device featured on the board allows Xilinx Embedded Development Kit (EDK) applications for the 32-bit Microblaze soft-core processor. Chapter 3 briefly presents the Xilinx Embedded Development Kit. In order to store larger data, the Nexys board is equipped with a Celular RAM and an Intel StrataFlash memory. The external memory allows running software applications larger than the internal FPGA Block-RAM size.

Although Xilinx offers various Embedded Memory Controller cores (EMC) suitable for the most of the memory devices available on the market, the Nexys board includes a CRAM and a StrataFLASH memory sharing the same buses. Therefore, using the Xilinx EMC devices led to memory errors. In order to resolve this issue, a custom memory controller was developed. Chapter 4 presents the custom memory controller for the Nexys memories. Because of the custom memory controller, the memories on the Nexys board are not accepted by EDK as Xilinx EMC compliant. Therefore the Flash programming of the application to be loaded and executed at the boot time is not possible directly from EDK.

Chapter 4 also presents the manual steps to be performed in order to prepare a software application to be executed from the external memory. Chapter 5 presents briefly the bootloader application provided by Xilinx, that handles the application stored in the external memory. Finally, conclusions are presented, aspects about the bootloader efficiency are discussed and further developments are highlighted.

2 THE DIGILENT NEXYS BOARD

The Nexys board [1] designed and manufactured by Digilent inc. allows the students to practice digital designs ranging from very simple designs with few logic gates and/or flip-flops, medium-level designs with well-known industry standard peripherals up to complex designs based on 32-bit microprocessor systems:

- The 8 LEDs, 8 slide switches and 4 push-buttons allow both simple combinational logic and sequential logic designs to show functionality of logic gates, decoders, multiplexers, counters and shift registers
- The 4-digit seven segment display allows simple designs that show the functionality of multiplexed 7-segment displays, like simple clocks, stopwatches, countdown timers, pulsemeters etc.
- The 6-pin Digilent PMOD connectors allow connecting and designing with industry standard low-speed peripherals such as:
    - Serial interface to work with RS232 protocol
    - PS/2 interface to work with PS/2 keyboard and mouse
    - Serial A/D and D/A connectors to work with SPI protocol interface
- The USB2 on-board interface allows high-speed data transmission between a PC and the development board. The USB2 interface at the board-end acts as a simple EPP interface, allowing design and experiments with handshake protocols
- There are 60 FPGA I/O pins routed to a high-speed FX2 connector, that allows connecting complex high-speed interfaces like the VDEC video decoder board
- The board features a connector for a 12-bit VGA interface or a text-mode or graphic LCD display, allowing to design and experiment with VGA display and controlling an LCD display
- The on-board 16 MB Celular DRAM memory allows to design and experiment with RAM memories both in asynchronous (SRAM) and synchronous (DRAM) mode. Also the on-board 4MB Intel StrataFlash memory allows to design and experiment with FLASH memories.
- The Spartan 3 XC2S200, 400 or 1000 FPGA on the board allows design complexities up to a 32-bit Microblaze soft-core microprocessor, that enables design and experimenting with a microprocessor system and IBM CoreConnect [2] compliant peripherals

In order to make simple to medium-level designs with the board, the only requirement is the free Xilinx Webpack software development environment and a USB cable. Figure 1 presents a picture of the Digilent Nexys board.

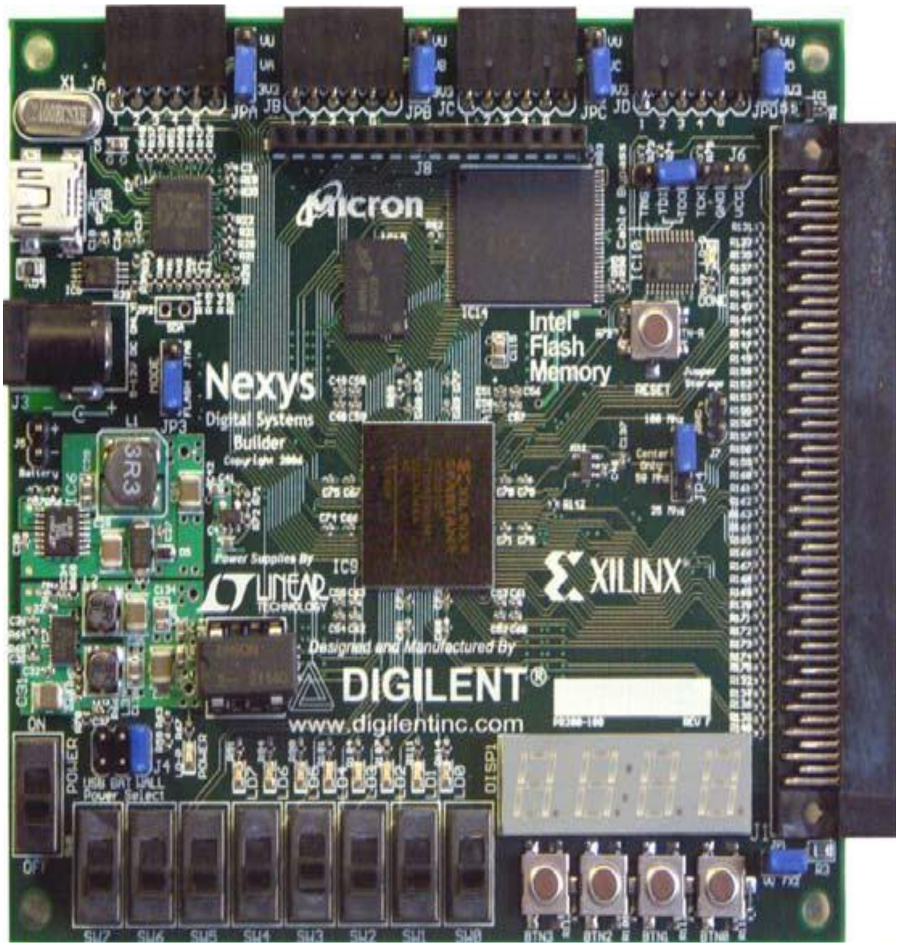


Fig 1. Picture of the Digilent Nexys board

In order to design with the Microblaze microprocessor system, Xilinx offers the Embedded Development Kit (EDK) [3].

3 XILINX EMBEDDED DEVELOPMENT KIT (EDK)

Xilinx EDK consists in a suite of design tools based on a common framework for a complete embedded processor system for implementation targeting a Xilinx FPGA device. The target processor is either PowerPc, available in hardware of Virtex2P and Virtex4 devices, or MicroBlaze, available up from Spartan3 devices.

EDK also offers a large set of IP cores, starting from low-speed peripheral devices like UART, PS2 or I2C interfaces, memory controllers for most of the SRAM, DRAM, DDRAM and Flash memory devices available on the market, to high-speed peripheral devices like Ethernet controllers.

The EDK features a Base System Builder wizard (BSB) that allows setting up a microprocessor system on the supported boards with minimum effort. The Base System

Builder is based on a Board Description file that includes information about the hardware peripherals available on the boards, the FPGA device and the user constraints (ucf) that contains the pin-to-peripheral pin connection information for various peripherals.

In order to expand the functionality, user-made peripherals can be imported into EDK and attached to the IBM CoreConnect On-Chip Peripheral Bus (OPB) [2] or Processor Local Bus (PLB), allowing the peripheral to be accessed by the microprocessor. Note that PLB devices are accepted only for PowerPc-based systems.

After the hardware system is built using BSB and the EDK Platform Studio interface, the project is passed through the Platform Generator utility that performs the implementation of the hardware system: transforming the hardware platform into a HDL netlist then into the FPGA-implemented bitstream.

EDK offers software support based on the GNU C and C++ compilers that perform library generation compiling and linking the software application into an Executable Linked Format (ELF) file.

The BSB offers also sample applications to show the functionality of various addressable peripherals.

Depending on the memory from which the application is planned to run – internal Block-RAM or external RAM, the ELF file is transformed into an initialization bitstream for the Block-RAM or programmed into the onboard FLASH memory, in the case of using external RAM. The BRAM initialization bitstream is mixed with the hardware bitstream and can be downloaded into the FPGA device. Figure 2 shows the EDK design flow [4]

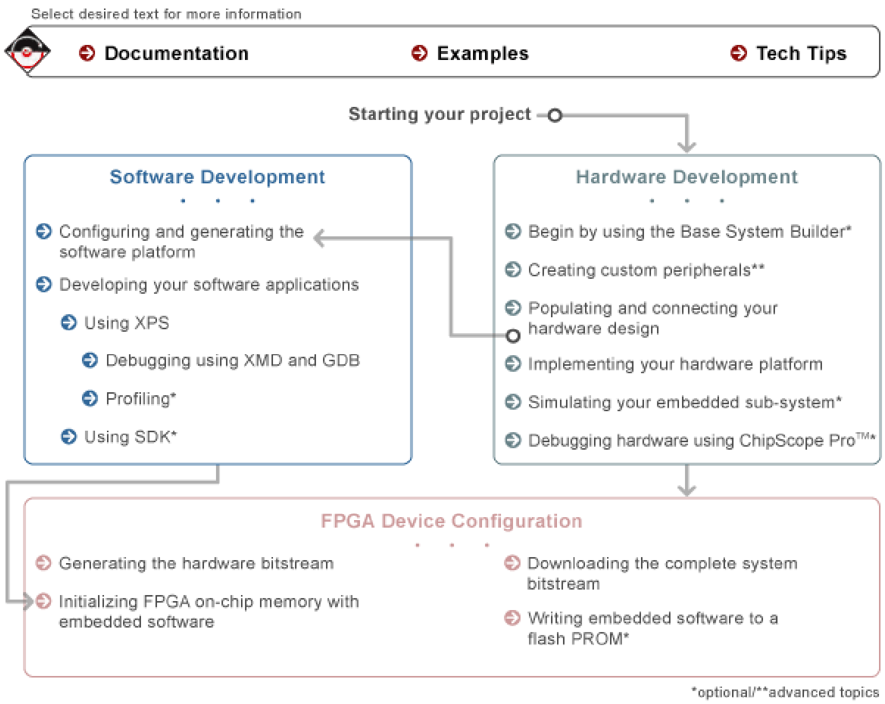


Fig 2. EDK design flow

The user designin g with EDK obviously takes the advantages offered by a higher-level description versus designs based only on HDL and schematic flow under ISE:

- The ease of building complex hardware systems in a few minutes only, without a high user effort
- Implementing complex algorithms is done in C or C++ instead of a state-machine approach under a HDL design language

In order to work with applications larger than the internal Block-RAM memory, an external memory controller has to be used. Due to the particularities of the Nexys board, a custom memory controller had to be built

4 NEXYS ONBOARD MEMORY CONTROLLER FOR XILINX EDK

Xilinx EDK features Embedded Memory Controller (EMC) cores that can be used for both the Nexys onboard Cellular RAM and the StrataFlash memory. However, due to the fact that the two different memories share the same address, data and control buses, the EMC core led to memory errors, therefore has proven to be unsuitable for the Nexys on-board memories.

Therefore a custom memory controller core, called NEXYS_EMC was designed and built. The core allows both Celular RAM and StrataFlash memory access. The memory controller is connected to the OPB bus. The CRAM memory can be accessed in 8-bit, 16-bit and 32-bit modes, whereas the FLASH memory can be written in 16-bit mode and can be read in 16 or 32-bit modes. Table 1 presents the various possible addressing modes for the Nexys onboard CRAM and FLASH memories:

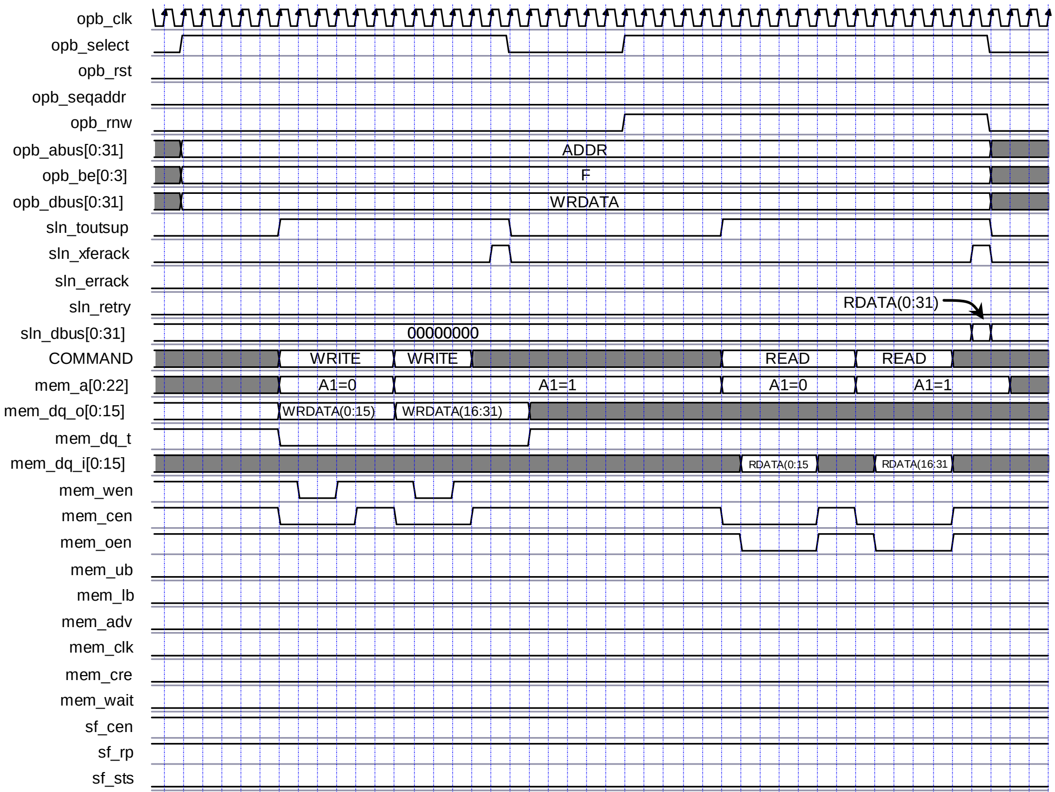
Table 1. CRAM and FLASH addressing for various access modes

Access mode	CRAM memory			FLASH memory		
	Lowest addres	**Highest address**	**Number of locations**	**Lowest addres**	**Highest address**	**Number of locations**
8-bit	BaseAddr	BaseAddr + 0xFFFFFF	16M	-	-	-
16-bit (Adresses multiple of 2)	BaseAddr	BaseAddr + 0xFFFFFE	8M	BaseAddr	BaseAddr + 0x3FFFFE	2M
32-bit (Adresses multiple of 4)	BaseAddr	BaseAddr + 0xFFFFFC	4M	BaseAddr	BaseAddr + 0x3FFFFC	1M

Note that all components in EDK, including OPB bus uses big endian data format, i.e. the most significant bit is always bit 0. The memory controller was designed to support both little and big endian memory models. Depending on the setting of an internal parameter, the memory controller performs byte alignment and rotation in order to store and read data form the memory in the corresponding endian format.

The OPB bus protocol requires byte alignment mechanism in the case of 8- or 16-bit access modes. Because the Nexys onboard memory devices connect to the FPGA on a 16-bit data bus, in the case of a 32-bit access the NEXYS_EMC core has to perform two consecutive write or read cycles to the memory. Figure 3 presents the NEXYS_EMC signal diagram in the case of a 32-bit write followed by a 32-bit read.

The NEXYS_EMC allows running applications from the external RAM memory. However, when downloading the hardware system into the FPGA, the external RAM has to be initialized with the application. Xilinx EDK offers to program a FLASH memory connected to a Xilinx Embedded Memory controller. At the startup the application stored in the FLASH memory is loaded into the RAM and executed.



Legend:

ADDR: Valid 32-bit address in the memory address range (multiple of 4)

WRDATA: Data to be written to the memory

RDATA: Data read from the memory

A1=0 - lower 16-bit aligned address

A1=1 – upper 16-bit aligned address

Fig 3. Nexys EMC SRAM 32-bit write followed by 32-bit read

However, the NEXYS_EMC, being a custom memory controller is not recognized as a Xilinx EMC device. Therefore the Nexys onboard FLASH memory programming directly from Xilinx EDK is not possible.

The solution found was to manually perform the steps required to prepare the application to run from the external memory, such as:

- Transform the application's ELF file into an S-record (SREC) format, using the objcopy utility, provided by the GNU tools included in EDK
- Program the SREC file into the FLASH memory, using Digilent's Memutil memory module utility [5].
- Load the Xilinx Bootloader application into the system's Block RAM

Because the Xilinx bootloader application is prepared for SREC format images, the application has to be converted into this format. An S-record file consists of a sequence of specially formatted ASCII character strings. An S-record will be less than or equal to 78 bytes in length. The order of S-records within a file is of no significance and no particular order may be assumed.

Digilent's Memutil application is a Windows application that provides a simple way to load data to and store data from the FLASH and RAM on the Nexys system board and the Digilent Mem1 module [5]. The Nexys USB peripheral provides the interface between the FPGA and PC. The Nexys demo design included in the Nexys board at delivery includes the project needed to program the onboard FLASH memory. The specific design can be also downloaded from the Digilent website.

The next step is to set up the EDK project with the bootloader application provided by the development kit.

5 THE XILINX EDK BOOTLOADER APPLICATION

The bootloader application was developed by Xilinx to be used especially by the Xilinx Microprocessor Debugger (XMD), but it is capable to boot any software application that is stored in SREC form in the FLASH memory, assuming that the SREC image in the memory is correct and the image location in the memory is known.

The bootloader needs only one parameter to be set by the user: the "FLASH_IMAGE_BASEADDR" parameter has to point to the correct physical address of the flash image location.

The basic operations performed by the bootloader are:

- Starting from the FLASH image address, decodes the each S record.
- If the S-record consists of data record types, i.e. S1, S2 or S3, then the program starting address is read and the data is copied into the RAM
- At each S-record the bootloader checks for the checksum. If an error is found, it is displayed on the STDOUT device and the bootloader stops execution
- If no errors found, the bootloader calls the address determined above, launching the program from the external RAM.

6 CONCLUSIONS

The Digilent NEXYS board proved to be a valuable tool in learning and experimenting digital designs from a beginner level up to complex microprocessor systems. Nevertheless, its low cost is comparable with the price of a textbook. Keeping in mind that Digilent boards are supported with many reference designs, results that a student learning digital design can choose a practical approach that leads to more efficient learning than by just lecturing a textbook.

The Nexys board allows also design and experiment of MicroBlaze – based microprocessor applications. However, due to the particularity of the Nexys onboard memories, using an embedded memory controller provided by Xilinx led to memory errors. In this paper a custom memory controller was presented. The memory controller allows accessing both the CRAM and the FLASH memory that share the same address, data and control buses.

Due to the fact that the custom memory controller is not recognized by Xilinx as an EMC device, in order to enable running applications larger than the size of the internal FPGA BlockRAM, a bootloader solution was described. Preparing the application for the bootloader requires manually performed steps such as the conversion of the ELF format to SREC format, programming the FLASH memory using the Memutil software application and downloading the bootloader code in the system built under EDK.

The bootloader solution offered in this paper is similar to the one offered by Xilinx EDK on its supported boards. Both methods suffer from the drawback that all the segments are programmed into the FLASH memory and loaded into the RAM. However, only the data segment should be loaded into RAM, the code segment could be run directly from the FLASH. Further developments include efficient segmentation and a custom bootloader solution that offers running application code directly from the FLASH memory.

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APPLICATIONS OF THE SYMBOLIC METHODS TO THE EARTH ELECTRODES CALCULATION

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Abstract: *In the paper it is presented a modern variant for the electrokinetic field analysis in solid conductors. The study refers to the pace voltage calculations in the case of a few types of the earth electrodes. The symbolic computation methods are utilized, by means of MAPLE program, which permits an accurate analytical calculation and the representation of the suggestive 3D images of the electric field spectrums, respectively, of the voltage funnels. The program can be used for the analysis of any configurations of the earth electrodes, with different shapes.*

Keywords: *electrode, electrokinetic, method.*

1 INTRODUCTION

The safety operation of the electrical installation and the protection measures of the life of the human beings who serve them, when unwanted states appear (short-circuits, over-voltages or transient states), depends on a suitable designing of the earth electrodes among other things.

The problem belongs to the domain of the study of the electrokinetic field in the solid conductor mediums.

After the electrokinetic field equations are written and on the basis of them, the electrostatic representation of the electrokinetic field is made, in the paper it is approached the pace voltage calculation in the case of the earth electrodes with the different shapes (sphere, cylindrical bar, hemisphere). The methods of the symbolic computation are used, utilizing the Maple simulation program.

2 ELECTROKINETIC FIELD EQUATIONS

The steady state electrokinetic field equations are those which the electrokinetic field state vectors $\bar{E}$ and $\bar{J}$ satisfy on. They represent the local forms of the electrokinetics fundamental relations, in the steady state [1], [2].

From electrokinetic potential theorem results:

$$\nabla \times \bar{E} = 0 , \tag{1}$$

or:

$$\bar{E} = -\nabla V , \tag{2}$$

the electric field $\bar{E}$ deriving from electrokinetic potential V.

The tangential components of the electric field intensity are preserved on the discontinuity surfaces:

$$\bar{E}_{t1} = \bar{E}_{t2} . \tag{3}$$

From the continuity theorem of the current lines for homogeneous conductors:

$$\nabla \cdot \bar{J} = 0 . \tag{4}$$

In the case of the discontinuity surfaces (uncharged: $\rho_s = 0$ or charged, only with $\rho_s(t) = const.$) the next relations are true:

$$\bar{J}_{n1} = \bar{J}_{n2} , \tag{5}$$

respectively (the refraction theorem of the current density lines):

$$\frac{\mathrm{tg}\alpha_1}{\mathrm{tg}\alpha_2} = \frac{\sigma_1}{\sigma_2} . \tag{6}$$

Since the metals can not be electric polarized, in the conductors:

$$\bar{D} = \varepsilon_0 \bar{E} . \tag{7}$$

From the electric conduction law for the isotropic and linear mediums:

$$\bar{E} + \bar{E}_i = \rho \bar{J} , \tag{8}$$

or:

$$\bar{J} = \sigma \left(\bar{E} + \bar{E}_i \right) = \sigma \bar{E} + \bar{J}_i , \tag{9}$$

and for the isotropic, homogeneous and linear conductors:

$$\bar{J} = \sigma \bar{E} . \tag{10}$$

From the law of the energy transformation in the conductors:

$$p_J = \bar{E} \cdot \bar{J} , \tag{11}$$

that becomes for the isotropic, homogeneous and linear conductors:

$$p_J = p_Q = \rho J^2 = \sigma E^2 , \tag{12}$$

and for the isotropic, inhomogeneous and linear conductors has the form:

$$p_J = \rho J^2 - \bar{E}_i \cdot \bar{J} = p_Q - p_G . \tag{13}$$

From the electric flux law, from (1) and (4) or from relaxation theorem:

$$\rho_v = 0 , \tag{14}$$

That is, in electrokinetic steady state the electric charge is distributed only on the conductors' surfaces or on the discontinuity surfaces, and the surface distribution of the charge results only from the electric field intensity distribution with $\rho_s = div_s \bar{D}$.

The above equations allow the determination of the $\bar{E}$ and $\bar{J}$ quantities when it is known the distribution of the inhomogeneous electric field $\bar{E}_i$.

On the other hand, it results that the electromotive force is given only by the inhomogeneous fields in the electrokinetic steady state, so that steady electric current can be produced only by the inhomogeneous field sources in the motionless conductors.

3 THE ELECTROSTATIC REPRESENTATION OF THE ELECTROKINETIC FIELD

From (4) and (9) with (2) results:

$$\nabla \cdot \bar{J} = 0 = \nabla \cdot \left(-\sigma \nabla V + \bar{J}_i \right),$$

or:

$$\nabla \cdot \left(\sigma \nabla V \right) = \bar{J}_i, \tag{15}$$

which represents the equation satisfied by the steady electrokinetic potential V in a linear medium with the inhomogeneous current density $\bar{J}_i = \sigma \bar{E}_i$ and in which the conductivity σ is function of point.

The relation (15) can be written as under the next form:

$$\sigma \nabla \cdot \nabla V + \nabla \sigma \cdot \nabla V = \nabla \cdot \left(\sigma \bar{E}_i \right) = \sigma \nabla \cdot \bar{E}_i + \bar{E}_i \cdot \nabla \sigma .$$

As $\nabla \cdot \nabla V = \Delta V$ results:

$$\Delta V = \nabla \cdot \bar{E}_i + \left(\bar{E} + \bar{E}_i \right) \frac{1}{\sigma} \nabla \sigma$$

or:

$$\Delta V = \nabla \cdot \bar{E}_i + \left(\bar{E} + \bar{E}_i \right) \nabla \left(\ln \sigma \right) \tag{16}$$

If $\sigma = const.$ from (15) and (16) results:

$$\Delta V = \frac{1}{\sigma} \nabla \cdot \bar{J}_i = \nabla \cdot \bar{E}_i, \tag{17}$$

that is a *Poisson equation* for the steady electrokinetic potential.

In homogeneous conductors ($\sigma = const., \bar{J}_i = 0$) the steady electrokinetic potential satisfies *Laplace equation*:

$$\Delta V = 0. \tag{18}$$

It is considered a linear conductor domain ($\sigma = const.$) ($\mathcal{D}_\Sigma$) in which n metallic electrodes are placed. The metallic electrodes have very large conductivity with respect to medium conductivity and can be considered perfect conductors. Therefore, they are equipotential, with the potentials V_k, $k = \overline{1,n}$ (fig. 1). The electrodes are fed from the outside exterior with the currents I_k by the insulated thin wires. If Σ_c is a surface which encloses the electrode k (with the exception of the place through which the insulated thin wire passes) bounded by the conductor medium σ and $\bar{J}$ is current density by surface Σ_c, then in accordance with the continuity theorem of the current lines.

$$I_k = \oiint_{\Sigma_c} \bar{J} \cdot \bar{n} \mathrm{d}A_k \tag{19}$$

In the domain $\mathcal{D}_\Sigma$ the $\bar{E}$ and $\bar{J}$ vectors satisfy the equations (1), (4) and (10), and potential V satisfies the Laplace equation (18). These equations can be solved directly taking into account the conditions on the surface of the domain $\mathcal{D}_\Sigma$, respectively the conditions on the equipotential surfaces Σ_c of the electrodes, for which have to be known either the potentials V_k, or the currents I_k. On the other hand, it is observed that the enumerated equations, according to electrokinetic field are analogous with the equations satisfied by the electrostatic field produced by n conductors charged with the charges q_k, having the potentials $V_k, (k = \overline{1,n})$ placed in a linear and uncharged insulated medium $(\rho_v = 0)$, with the same geometrical configuration.

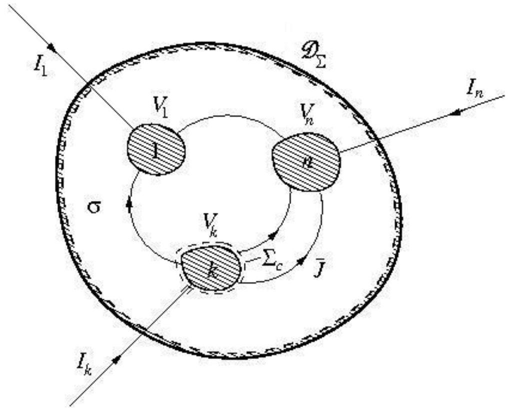

Fig. 1. Relative to the placing of the electrodes in a medium with the finite conductivity

This allows to be made an analogy between electrostatics problems from uncharged dielectrics and those of the electrokinetics steady state in the homogeneous solid conductors.

The analogy of the equations and the analogy of the state quantities between the two regimes are given back in the tables 1 and 2.

Tab. 1: Analogy between electrostatics and electrokinetics equations

Electrostatics equations	*Electrokinetics equations*
$\nabla \times \bar{E} = 0$	$\nabla \times \bar{E} = 0$
$\bar{E} = -\nabla V$	$\bar{E} = -\nabla V$
$\nabla \cdot \bar{D} = 0$	$\nabla \cdot \bar{J} = 0$
$\bar{D} = \varepsilon \bar{E} + \bar{P}_p$	$\bar{J} = \sigma \bar{E} + \sigma \bar{E}_i$
$\bar{D} = \varepsilon \bar{E}$	$\bar{J} = \sigma \bar{E}$
$\Psi_k = \iint_{S_\Gamma} \bar{D} \cdot \bar{n}\, \mathrm{d}A = q_k$	$I_k = \iint_{S_k} \bar{J} \cdot \bar{n}\, \mathrm{d}A$
$\Delta V = 0$	$\Delta V = 0$
$E_{t_1} = E_{t_2}$	$E_{t_1} = E_{t_2}$
$D_{n_1} = D_{n_2}$	$J_{n_1} = J_{n_2}$

Tab. 2: Analogy between electrostatic and electrokinetic field

Electrostatic field	*Electrokinetic field*
$\bar{E}$	$\bar{E}$
V	V
$\bar{D}$	$\bar{J}$
$\bar{P}_p$	$\bar{J}_i = \sigma \bar{E}_i$
$\Psi_k (\text{sau } q_k)$	I_k
$D_n = \rho_s$	J_n
ε	$\sigma = \frac{1}{\rho}$
C	G
C_{kj}	G_{kj}
$U_{12} = V_1 - V_2$	$U_{12} = V_1 - V_2$
$C = \frac{q}{U_{12}}$	$G = \frac{I}{U_{12}}$
$S = \frac{1}{C}$	$R = \frac{1}{G}$
$\frac{\mathrm{tg}\,\alpha_1}{\mathrm{tg}\,\alpha_2} = \frac{\varepsilon_1}{\varepsilon_2}$	$\frac{\mathrm{tg}\,\alpha_1}{\mathrm{tg}\,\alpha_2} = \frac{\sigma_1}{\sigma_2}$

Therefore, the correspondence between the quantities allows the realization of a physical analogy. In consequence the solving of the electrokinetic field problems can be made by the utilization of the results known from the study of electrostatic field.

4 EARTH ELECTRODES. PACE VOLTAGE. APPLICATIONS

4.1 Earth Electrodes

The earth electrodes are devices which realize directly an electric conductive link with the earth. This link refers either to certain points of the electric networks, when it is pursued the realization of a certain current circulation, or to conductive parts of the protective installation, of the electric machines and apparatus, when it is pursued the protective insurance against the electrocution danger of the human beings or animals.

The fundamental problems of the earth electrodes are the determination of the resistance to earth, respectively, of the pace voltage.

After the manner of disposition, the earth electrodes can be: a) depth earth electrodes, b) surface earth electrodes. After the shape, they can be of spherical, hemispherical, cylindrical, tubular or plate shapes.

4.2 Pace Voltage

The voltage distribution at the earth surface, when the earth electrode is crossed by the current, can put in danger the human being and animal life round about the electrode earth.

The voltage between the soles of the human being, who is situated on the electric field direction on the earth surface and come near to the earth electrode, is named *pace voltage.*

4.3 Applications

Further it is presented the symbolic computation of the electrokinetic fields in the case of the earth electrodes with the different shapes, by means of Maple program. It is followed the pace voltage calculation with the relation:

$$U_p = \int_{r-p/2}^{r+p/2} \overline{E} \cdot \mathrm{d}\overline{r} \,, \tag{20}$$

on the basis of the analogy between electrostatics problems from the uncharged dielectrics and those of the electrokinetics steady state in the homogeneous solid conductors (§3).

Application 1: The pace voltage calculation in the case of spherical earth electrode with the a radius, and placed to the h depth.

Application 2: The pace voltage calculation in the case of cylindrical earth electrode with l length, and placed to the h depth.

Application 3: The pace voltage calculation in the case of hemispherical earth electrode with the a radius, and placed to the earth surface.

For numerical applications the next values were used: the injected current in the earth electrodes $I_p = 50\ \mathrm{A}$, the pace length $p = 0{,}6\ \mathrm{m}$, the earth conductivity $\sigma = 0.01\ \mathrm{S/m}$, the radius for spherical and hemispherical earth electrodes $a = 0{,}5\ \mathrm{m}$ and the depth $h = 1\ \mathrm{m}$.

On the basis of the obtained solutions the electric field spectrums, respectively, the voltage funnels was plotted for the three earth electrodes.

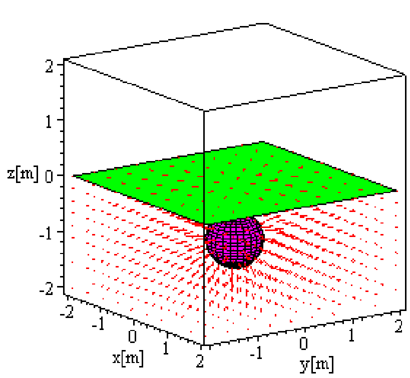

Fig. 2: The electric field spectrum for the spherical earth electrode

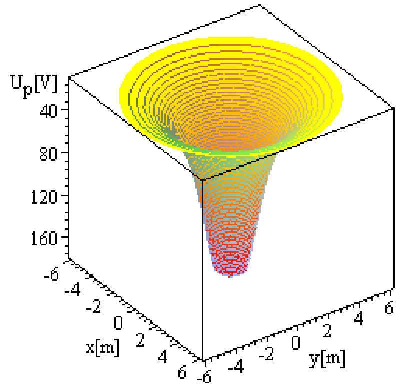

Fig. 3: The voltage funnel for the spherical earth electrode

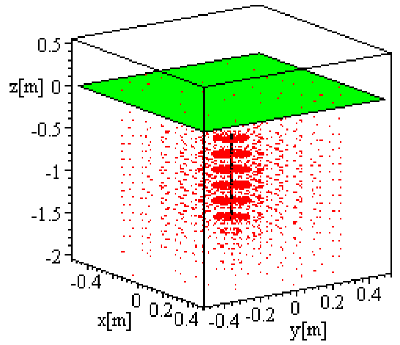

Fig. 4: The electric field spectrum for the cylindrical earth electrode

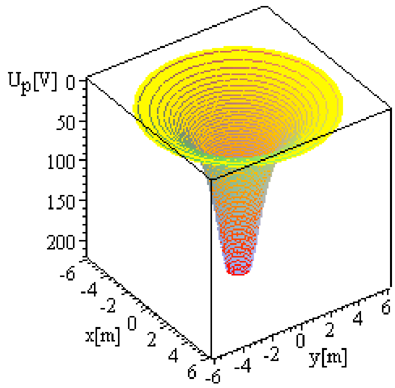

Fig. 5: The voltage funnel for the cylindrical earth electrode

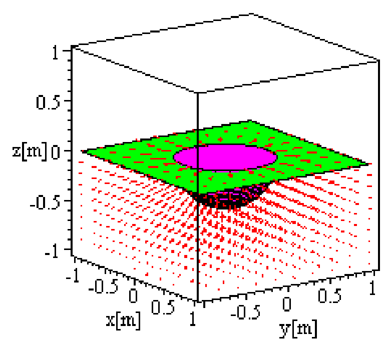

Fig. 6: The electric field spectrum for the hemispherical earth electrode

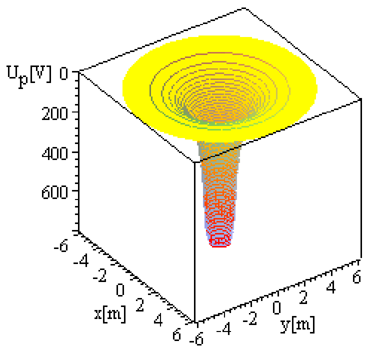

Fig. 7: The voltage funnel for the hemispherical earth electrode

5 CONCLUSIONS

1. The paper presents a new approach regarding to the calculation of the electrokinetic field in the solid conductors. The symbolic methods are used which have the following advantages:

- the development of the modeling skills, useful in the approach of others more complex problems;
- facilities in the treating of the limit cases (and of the degenerate cases, eventually);
- a better understanding of the physical phenomena corresponding to the analyzed field problem.

2. The Maple program was used which permits an accurate analytical calculation and the representation of the suggestive 3D images of the electric field spectrums, respectively, of the voltage funnels.

3. In the paper three types of the earth electrodes were studied as models of the applications. However, the program permits the analysis of any configurations of the earth electrodes, with different shapes.

4. The pace voltage calculation for the three applications was made considering $z = 0$ (on the earth surface), but the program allows the study and in the case $z \neq 0$ (on the different depths).

5. From the study of the three theoretical models which was analyzed (depth spherical earth electrode, depth cylindrical earth electrodes, respectively, surface hemispherical earth electrode) resulted that the smallest protective radius (therefore the best efficacy) corresponds to the cylindrical earth electrode.

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DES SOLUTIONS TECHNIQUES POUR L'ACTIONNEMENT INTEGRALE DES AUTOVEHICULES AVEC DES MOTEURS ELECTRIQUES

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Abstract: *Le véhicule électrique est une réalité de nos jours et représente une perspective prometteuse pour le futur. Des entreprises prestigieuses du domaine des automobiles (FORD, TOYOTA, GENERAL MOTORS, HONDA, MITSUBISHI, FIAT, RENAULT etc.) ont obtenu des résultats particuliers et continuent toujours leurs travaux de recherche. En Roumanie le domaine est d'actualité et il est très bien représenté. On a obtenu des résultats remarquables dans le domaine des moteurs électriques utilisés pour actionnement. Parmi les spécialistes ayant des préoccupations et des réalisations nationales, il y a aussi les auteurs de cet article.*

Keywords: *moteur, autovehicule, technique*

1 INTRODUCTION

Une analyse attentive et responsable de l'évolution mondiale des systèmes de propulsion pour les véhicules ont mis en évidence la nécessité et l'importance de trouver des variantes viables en tant qu'alternative à l'utilisation à une échelle plus large du combustible fossile, fait dû principalement à la réduction dramatique des réserves internationales de combustible primaire, de même qu'à la nécessité actuelle de réduction des facteurs polluants de destruction de l'environnement.

C'est pourquoi les stratégies actuelles, politiques, économiques, scientifiques, et technologiques sont orientées vers la conception des systèmes de propulsion pour les véhicules qui réalisent l'énergie électrique, et cela dans l'espoir que dans le futur proche les batterie d'accumulateurs seront à même de stocker une grande densité électrique, énergie qui pourrait être générée de manière significative par des moyens considérés actuellement non conventionnels. Les réalisations de certains consortiums de recherche et développement et des certaines entreprises dans le domaine auto concernant la conception, le développement et la fabrication des véhicules à propulsion électrique ou hybride sont déjà connues. Généralement, on conserve la structure de l'automobile classique, comme structure de propulsion, mais le moteur thermique est remplacé ou complété par un moteur électrique.

2 ELIMINATION DES SYSTEMES MECANIQUES INTERMEDIAIRES PAR LE MONTAGE DES MOTEURS ELECTRIQUES AUX ROUES

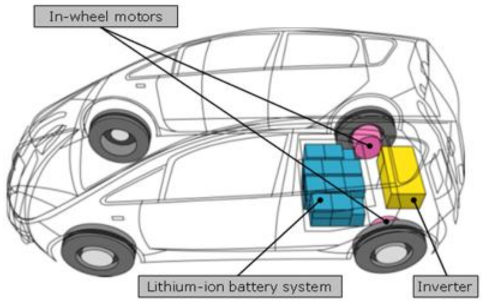

Fig. 1. Vue d'ensemble générale

Dans le cas des véhicules à traction intégralement électrique, on a développé au niveau mondial, deux variantes constructives: Une variante à un seul moteur électrique qui garde la transmission mécanique de la voiture classique, et la variante à moteurs sur les roues qui emploie deux ou quatre roues motrices. Dans la figure 1, on représente la structure d'une automobile à deux roues motrices montées sur le pont arrière du véhicule réalisée par MITSUBISHI–le type Colt EV. [2]

Les tendances actuelles dans le domaine sont le résultat des principaux avantages que le montage du moteur dans la roue représente, on n'opère qu'un minimum de modifications dans le système déjà existent, en plaçant les moteurs aux roues avant (les roues directrices du véhicule) de même qu'arrière - on renonce au différentiel et au démultiplicateur qui provoquent des pertes énergétiques supplémentaires, on réalise un actionnement du véhicule à un bruit réduit et à efficience énergétique élevée, à un contrôle extrêmement fin sur une plage élevée de rotations, autant pour l'actionnement de deux moteurs, de même que pour l' actionnement indépendant de quatre roues, ce qui s'avère être extrêmement utile dans le cas des véhicules qui se déplacent sur la neige, dans la boue etc. dans ce cas là, étant possible le freinage récupérateur.

3 BREVE PRESENTATION DES SOLUTIONS DE MOTEURS

Les principaux avantages de l'utilisation des moteurs électriques: caractéristique mécanique plus avantageuse, on constate que le moteur électrique réalise le couple maximum au moment même du lancement et celui-ci reste constant jusqu'à une certaine rotation, ce qui permet de renoncer à la boite de vitesses et le fonctionnement du véhicule sera doux, pareil à celui des véhicules équipés des boîtes automatiques à transmission continue. La puissance du moteur électrique croît de manière linéaire au début, puis reste constante simultanément avec la diminution du couple. À des rotations très grandes, la puissance commence à diminuer. rendement plus grand – d'habitude les moteurs électriques ont des rendements de plus de 80% et le rendement croît avec la puissance nominale et se maintient élevé sur une plage grande du domaine de fonctionnement; puissance spécifique plus grande, les moteurs peuvent atteindre une puissance spécifique de plus de 0,8kW/Kg, les dernières générations de moteurs électriques comme sont ceux à aimants permanents de terres rares ont une puissance spécifique beaucoup plus grande, sans coûts excessifs, ce fait a eu comme effet leur emploi préférentiel dans la traction. Il est possible le freinage avec récupération d'énergie, la machine électrique passe du régime moteur au le régime générateur et transforme l'énergie cinétique du véhicule en énergie électrique qui puisse recharger les batteries.

L'énergie électrique récupérée est inversement proportionnelle avec la rotation, ce qui rend le freinage récupérateur plus efficace et fait que l'énergie récupérée soit significative seulement à des vitesses de plus de 15÷20km/h; en moyenne on peut récupérer un pourcentage d'à peu près 30% de l'énergie cinétique du véhicule, ce qui agrandit le rendement du système électrique; La commande plus commode et plus complexe- la variation de la rotation se fait de manière continue, en gardant un point de fonctionnement proche de l'optimal et le système peut être beaucoup plus aisément contrôlé (on peut contrôler de manière permanente le couple maximal pour ne pas produire des effets biologiques désagréables au moment des accélérations trop grandes, on peut contrôler le profil du couple maximal de telle manière qu'il permette le développement pour un laps de temps d'un couple pulsionnel plus grand, au moins double, on peut contrôler le régime de recharge des batteries au freinage récupérateur etc. Le système basé sur les moteurs électriques a une dynamique meilleure et une fiabilité accrue

3.1 L'utilisation d'un moteur electrique special pour l'actionnement des vehicules electriques dans le but d'eliminer le demultiplicateur mecanique

En principe, tout type de moteur électrique existant pourrait être employé pour l'actionnement des véhicules. Mais à cause des caractéristiques spécifiques qui apparaissent chez les véhicules, les moteurs utilisés doivent présenter une série de caractéristiques particulières qui les singularise par rapport aux moteurs utilisés dans d'autres applications. Parmi leurs caractéristiques, on peut rappeler le gabarit réduit, le couple spécifique de valeur élevé, la vitesse de rotation plus basse à un couple plus élevé, le rendement de valeur grande, robustesse et fiabilité, prix compétitif etc..

Il est souhaitable qu'un moteur utilisé pour l'actionnement des véhicules permette, autant que possible, l'élimination totale d'autres éléments mécaniques (boite de vitesses, embrayage etc.) pour qu'on fasse améliorer le rendement global énergétique (on sait que la source d'énergie électrique est l'élément le plus sensible d'un véhicule électrique). Même şi l'on élimine les éléments ci-dessus, d'habitude on associe au moteur un démultiplicateur mécanique pour rendre possible le développement d'une puissance suffisante dans le volume permis par l'espace disponible. Le démultiplicateur est souvent un élément moins fiable qui complique la géométrie du système d'actionnement. Quand on soulève le problème du montage du système d'actionnement dans la roue du véhicule ou tout près d'elle, l'aspect rappelé ci-dessus peut se transformer en un obstacle sérieux. C'est pourquoi, il a apparu la nécessité d'utiliser un moteur spécial qui puisse être couplé directement, sans démultiplicateur mécanique, en raison de sa capacité de fonctionner à une vitesse réduite (même en régime de rotor bloqué) conditions où il peut développer une puissance suffisante pour l'actionnement du véhicule. Ce moteur est un moteur de courant continu spécial, ayant un nombre réduit de gorges sur le pôle. (pratiquement un gorge) ce qui rend possible une construction présentant un nombre élevé de pôles. On sait que c'est justement ce fait qui permet d'obtenir un volume réduit pour une constante de couple assez grande.

3.2 Particularites concernant la construction du moteur de courant continu choisi

Ce moteur, en principe, a une construction ressemblant à tout moteur de courant continu, sauf que le nombre des gorges élémentaires est plus grand que le nombre de pôles élémentaires, d'un seul élément. (le moteur dans cette construction peut être multiplié d'un certain nombre de fois, les structures élémentaires étant connectées en série ou en parallèle selon le cas. Le nombre réduit de gorges permet que le moteur soit construit avec un nombre plus grand de pôles, c'est pourquoi le gabarit, pour un couple spécifique donné, peut être réduit de manière convenable. Il y a encore d'autres éléments spécifiques de fonctionnement qui conduisent à un rendement global plus grand, ce qui, si l'on admet un rendement convenable, rend possible la réduction du gabarit du moteur. Constructivement, on considère une configuration optimisée ayant 9 gorges et 8 pôles multipliés par 3. Toutes les sections seront connectées en parallèle.

Il en résulte 27 gorges et 24 pôles. Le nombre de balais est de 24. Les sections qui se trouvent momentanément en régime de court-circuit produisent du couple utile en moyenne et celui-ci consomme une partie de l'énergie magnétique accumulée dans les bobines. C'est pourquoi il est possible qu'il n' y a pas de coïncidence parfaite entre la valeur de la constante t.e.m pour une section et celle de la constante de couple.

3.3 Particularites concernant le fonctionnement du moteur de courant continu choisi

Vu la spécificité du moteur, celui-ci peut être considéré comme un nombre de circuits complexes (avec des éléments résistifs et inductifs dans un champs magnétique) connectés en parallèle à la source d'alimentation de courant continu. Parfois, pour peu de temps, deux ou plusieurs sections peuvent se retrouver en série et dans ces conditions peuvent se connecter en parallèle avec les autres sections où peuvent être court-circuités par deux balais de la même polarité.

Ainsi construit, le moteur ne fonctionne pas en régime de générateur car dans ce régime il faudrait qu'on mette en parallèle les sources avec des tensions aux bornes ayant des valeurs de 0 jusqu'à la valeur maximale de telle sorte qu'il pourrait apparaître des courants de circulation. De toute façon, la tension aux bornes en tant que générateur serait proche de 0, ce qui le rendrait inutilisable. En essence, le principe de fonctionnement peut être expliqué de cette façon: la tension électrique de c.c. est appliquée au système de balais d'alimentation, en parvenant aux barres de commutation de telle manière qu'on réalise les polarités adéquates, les barres de commutation retransmettent la tension aux sections d'enroulement et les courants engendrés dans les conducteurs produisent un champs de réaction qui réagissent avec le champs inducteur, ayant pour résultat le développement d'un couple électromagnétique; les valeurs des courants de diverses sections sont telles que les courants plus grands apparaissent dans les sections qui se trouvent sous le champs magnétique plus faible, car ces sections t.e.m ont des valeurs plus basses- ce fait conduit à la production d'un couple électromagnétique qui résulte de manière beaucoup plus uniforme que dans le cas de la voiture classique.

Dans les conditions ci dessus, les équations qui caractérisent le fonctionnement d'un moteur du type de celui décrit, pour le cas général d'un nombre de n sections, seront [1]:

$$u_1 = R_1 \cdot i_1 + \frac{d}{dt}\left(l_1 \cdot i_1\right) + \frac{d}{dt}\left(m_{2,1} \cdot i_2 + m_{n,1} \cdot i_n\right) - N_1 \frac{d}{dt}\varphi_{e1} + u_{a1} + u_{p1}$$

. (1)

.

$$u_k = R_k \cdot i_k + \frac{d}{dt}\left(l_k \cdot i_k\right) + \frac{d}{dt}\left(m_{k-1,k} \cdot i_{k-1} + m_{k+1,k} \cdot i_{k+1}\right) - N_k \frac{d}{dt}\varphi_{ek} + u_{ak} + u_{pk}$$

.

.

$$u_n = R_n \cdot i_n + \frac{d}{dt}\left(l_n \cdot i_n\right) + \frac{d}{dt}\left(m_{1,n} \cdot i_1 + ... + m_{n-1,n} \cdot i_{n-1}\right) - N_n \frac{d}{dt}\varphi_{e1} + u_{a1} + u_{p1}$$

$$u_1 = u_2 = \ldots = u_k = \ldots = u_n = u$$

$$i_1 + i_2 + \ldots + i_k + \ldots + i_n = i$$

4 CONCLUSION

Les moteurs électriques représentent une solution extrêmement avantageuse pour l'actionnement des véhicules. On peut utiliser pratiquement tout type de moteur présenté, mais les moteurs basés sur excitation à aimants permanents de terres rares connaissent des performances qui sont supérieures aux autres. L'utilisation d'un démultiplicateur mécanique peut générer une solution d'action ayant une puissance spécifique élevée, mais on peut considérer également une solution direct drive, cas où le moteur doit développer un couple élevé même à de vitesses petites de rotation – dans ce cas là, il est nécessaire d'employer un moteur spécial, caractérisé par couple spécifique très élevé. Il faut souligner que cette solution est agréée pour l'actionnement des véhicules de puissance petite et moyenne. Quand il s'agit de puissance grande, il faut envisager une solution mixte moteur démultiplicateur mécanique.

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ABOUT IMAGE COMPRESSION ALGORITHM USED IN MOBILE CONTINUOUS MONITORING SYSTEMS

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Abstract: *Mobile continuous monitoring systems start to grow in every modern army. They are also known as UAV (Unmanned Air Vehicle) and probably in few years almost every army will be equipped with UAVs. The goal of this paper is to present an algorithm that compress images captured from the UAV and transmitted to the ground. This paper focuses on the image compression algorithm presenting simple techniques that can be combined for a high compression ratio, with low resources and a good quality*.

Keywords: *algorithm, mobile, UAV.*

INTRODUCTION

Image compression offers advantages for real time transmitting but also for future processing, and for an UAV this is a requirement thanks to the low resources that can be used on a UAV. For every modern army, using an UAV become a priority mostly for their reduce size, low costs involved and the human life that are protected. The goal of this paper is to develop a real time image compression algorithm optimized for missions such as transmitting the images to the ground. The criteria imposed are:

- low processing resources;
- low bandwidth used for transmitting a high number of frames per second;
- using the algorithm on different platforms and offers the facility to be imported on hardware platforms as DSP or FPGA.

I MOTIVATION: A BATTLEFIELD SITUATION

Fig. 1 An UAV built by Professor Nicolae JULA [9]

Here is the perspective: There is a battlefield and we need to track from a neutral area the enemy's movement, or in retreat situation, from an under siege city we need to analyze the number of the enemy troop's shifts. So, we need a monitoring system to transmit, without frequencies limitations and using low resources, images captured from that area and in the case the system is mobile, this is a huge advantage. Such a system can be an UAV equipped with an image acquisition device remotely operated (with help from the transmitted images) or by a GPS with an initially map defined.

An UAV, helicopter type was built by Professor Nicolae JULA [9] and can be used in such situations. A picture of that UAV is presented in Figure 1. The flow chart of the situations is described in Figure 2. This paper will deal with the grey block that means the image processing block.

The situation shown in Figure 2 can be described as bellow: *A mobile monitoring system, in this example an UAV equipped with image acquisition and radio transmitting devices, capture the images, processing its for the transmission (synchronous, compression, encryption) and transmit its to the ground using a radio channel with low energy and processing resources. On the ground, at a medium distance, the user with a laptop, is viewing the images and save it for further processing. Using the same radio channel, the user will remotely control the UAV helped by the images received in real time, so the radio channel will be duplex.*

II HARDWARE: THE PLATFORM

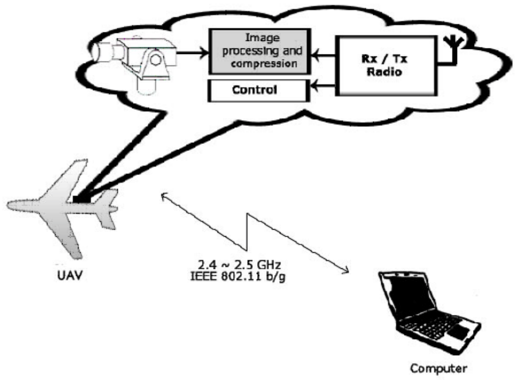

Fig. 2 Diagram of an perspectives

The first step was to analyze a platform that will be used on the UAV. For that, firstly I try to use an all in one solution, such as a router that can be reprogrammed. A cheap but "smart" model is Asus WL 500G that costs only 130$. The advantages of the router are offers modules included and it eliminates the needs of the encryption and of the radio communication because the model mention previously has included these modules: AES for the encryption and IEEE 802.11 b/g for the radio communication.

The first problem appeared from the processor included on the router: it has only 266 MHz and because of that, the compression cannot be realized with a many number of the frames, thus another platform will be searched.

Many solutions come form VIA: they developed many motherboards of low size, medium power and low energy requirements. The motherboard that can be achieved is LEX CV700C and cost 550$. This is a more expensive solution than the router but has the advantages that the processor has the frequency of 1 GHz. As have been told, the solution is not unique and other better solution from VIA exists but, importunely, they could not be acquired. Let us now developed an algorithm and test it on the VIA platform.

III SOFTWARE: THE PROPOSED CODER

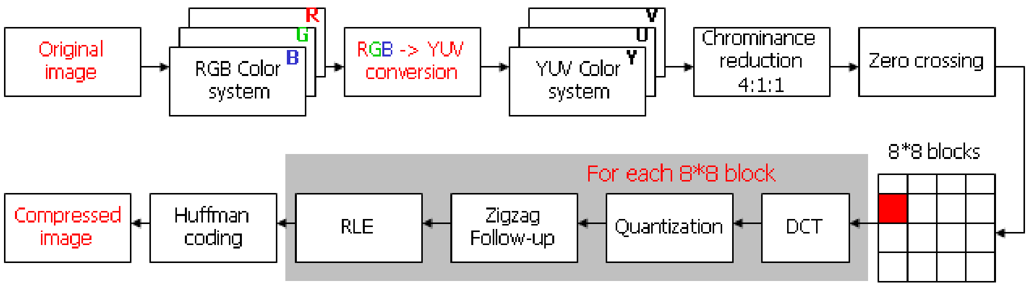

Fig. 3 The block scheme of the coder that is proposed for the compression algorithm

Firstly, the block scheme is presented in Figure 3. Every step of the algorithm will be explained following one example, for a better representation.

A. Uncompressed image

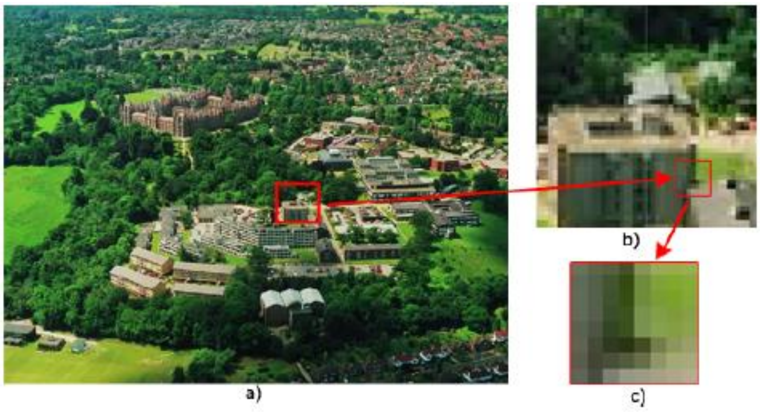

Fig. 4 The original image. a. the complete image. b. zoom on the image.
*c. 8*8 block extracted*

Because the goal of the paper is to explain an optimized algorithm of image compression that can be used on real time transmitting with low processing resources, it won't be insisted on the capture from the optical sensor, thus the frames will be considered BMP images. The BMP images are uncompressed images with maximum 24 bit depth and use the RGB color system. The explanation will be followed the image presented in Figure 4.c that is extracted from Figure 4.a.

R	G	B
107 94 86 71 132 152 152 155	114 102 97 82 149 171 172 174	89 71 64 43 86 88 74 84
95 84 66 52 112 129 130 136	107 96 86 75 140 161 169 172	88 74 49 18 61 60 45 58
96 83 63 54 111 124 123 133	108 96 83 78 140 156 163 169	90 76 46 20 61 55 41 57
99 87 60 60 121 130 128 135	105 95 79 83 147 158 156 160	89 76 44 31 79 71 58 72
91 78 51 59 122 134 133 140	98 86 70 81 146 161 158 162	81 67 36 31 82 79 67 79
96 70 48 43 69 118 141 156	99 74 57 53 78 126 150 159	83 56 33 20 35 75 92 108
90 67 73 83 104 145 163 168	93 70 81 92 111 150 169 170	78 53 59 62 73 104 117 123
95 74 125 150 156 167 174 183	101 77 128 151 155 161 167 171	90 65 115 134 132 137 139 148

Fig. 5 RGB values for the images

Extracting the RGB values from the image mentioned previously, the values are presented in Figure 5.

B. RGB -> YUV Conversion

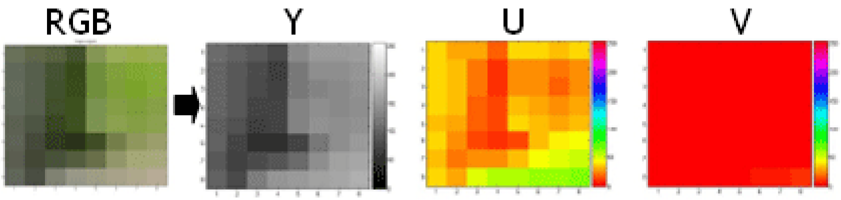

Fig. 6 YUV representation

The conversion is realized using simple linear operation. For that the equations that are used are presented bellow. As can be seen, the operations use a low complexity step, as we proposed at the beginning of the paper.

RGB->YUV conversion offers many advantages: for example, if there is aproblem with the radio communication it can be selected for transmitting, only the Y components, which represent a grayscale image. This will offer a compression without any effort.

The advantage of the YUV conversion can be seen on the example analyzing the values.

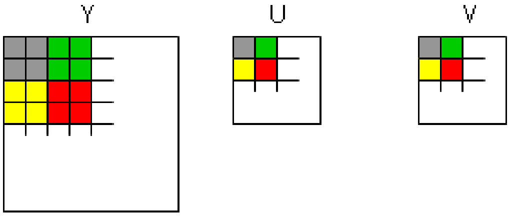

Fig. 7 Chrominance reduction

C. Chrominance Reduction

The reduction is based on the human eye property that is more sensitive to the luminance than to the chrominance thus for that, instead of blocks of *n* size for every component, it will result 3 blocks such as: *n* size for the luminance and *n/2* size for U and V components that are chrominance components. From now, it will be analyzed only the Y block to simplify the explanation. The steps for the U and V components follow the same principles.

D. Center to Zero the Values

The values for the Y, U, V blocks are between 0 and 255 based on the fact that for every block it will be used 8 bits for the bit depth. For a faster computation on the Discrete Cosines Transform (it will be explained later in the paper), a representation between [-128, 127] is preferred.

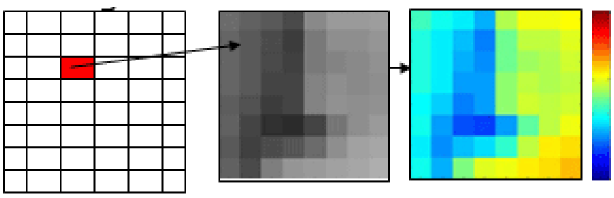

Fig. 8 A luminance block extracted from the image

E. Extracting 8*8 Blocks

This is used for a low computations cost. The size of 8*8 is selected because for a smaller size than 8*8, a part of the correlation between pixels will be lost, and for higher size, the computation cost will grow exponentially with only a small higher correlation that in the 8*8 situation. In Figure 8 is illustrated the extracting step, the luminance block extracted and the representation of the values in a color system for an easy follows of the next steps.

F. Applying Discrete Cosines Transform

Discrete Cosines Transform (DCT) has the main property of compacting the energy of the image in low frequencies. In our case, it will be applied the DCT-2D (2 dimensional), that has the formula:

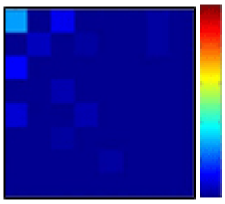

Fig. 9 DCT coefficients

$$F(u) = \sqrt{\frac{2}{N}} C(u) \left[\sum_{x=0}^{N-1} f(x) \cos \frac{(2x+1)u\pi}{2N} \right] \text{ where } \begin{array}{l} C(u) = \frac{1}{\sqrt{2}}, \textit{ for} \quad u = 0; \\ C(u) = 1, \textit{else} \end{array}$$

Another way to express the effect of the DCT-2D on a image is that the coefficients resulted represent "how much vary the intensity [8]" and not the intensity value itself.

For the block extracted from the image, the DCT coefficients represented in a color scheme are illustrated in Figure 9.

G. Quantization

This step is used to establish the compression ration and the quality of the image. The quantization is not scalar, but is a linear one. Thus, for every component (Y, U, V), another matrix of quantization will be applied. For example, for the luminance block, the quantization matrix applied is presented in Figure 10 and the results are illustrated in Figure 11 and Figure 12.

The importance of this step is that here we can use many variance of the matrix, thus it can be established the compression ratio (and also the bandwidth necessary), and the quality of the image. The matrix proposed follows that the quality of the image, measured with the PSNR (Peak Signal Noise Ratio) has to be all the time at least 30dB (that means a good quality of the image).

4	3	2	4	6	10	13	16
3	3	3	5	7	14	15	14
2	3	4	6	10	14	17	14
4	5	6	9	13	22	20	16
6	7	10	13	17	28	26	19
10	14	14	22	28	26	28	23
13	15	17	20	26	28	30	26
16	14	14	16	19	23	26	25

Fig. 10 Quantization matrix

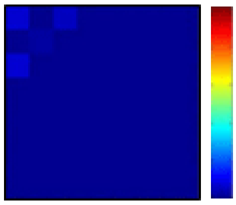

Fig. 11 Quantized coefficients (color)

17	24	13	0	0	0	0	0
-6	5	0	1	-1	0	0	0
16	-9	0	1	0	0	0	0
-2	0	1	0	0	0	0	0
3	-1	-1	1	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Fig. 12 Quantized coefficients (numeric)

It can be seen that a lot of coefficients becomes zero values, thus the next steps will offer a better representation of the zero values.

H. Zigzag Follow-Up

By this follow-up of the 2D dimensional vector, it will result a 1D dimensional vector, useful for Run Length Encoding (RLE) coding. The advantage appears after DCT, because the nulls coefficients are mostly under the secondary cross-bar of the matrix. The 1D dimension vector will be easy to code with a high ratio compression using RLE (it will be presented in the next step).

J. Run Length Encoding (RLE)

RLE is based on constitute pairs (number of zeros before the non-zero x value, value x). The ratio compression obtained for this code is 2:1 or 3:1 because the image contains a uniform area like the sky, the grass. The last bits of zeros are noted (0, 0). An example of an 8*8 RLE coded matrix is shown bellow:

(0,17) (0,24) (0,-6) (0,16) (0,5) (0,13) (2,-9) (0,-2) (0,3) (2,1) (0,30 (1,-1) (0,1) (0,1) (0,-1) (2,-1) (0,0)

It is visible that instead of 64 elements, we will have 34 elements, after a simple operation.

K. Huffman Encoding

The Huffman encoding follows the classical algorithm with few changes: it will be applied on the image, not on the blocks but for 256 coefficients for one coder. For that, many matrix of Huffman coding are built before and adapted for all situations. Thus, the Huffman encoding is an entropic encoding and for images offers usually a compression ration equal with 3:1. For that, it will be used dictionaries. For the example presented, the dictionary is:

Simbol	0	1	2	-1	3	17	24	-6	16	5	13	9	-2
Codare	0	1111	1110	1101	1100	10101	10100	10111	10110	10001	10000	10011	10010

and the binary code is:

010101010100010111010110010001010000111010011010010011001110111101100111111010110101111011011111000

V OPTIMIZATION

The coder proposed can be optimized following the next situations presented initially:

- low processing resources: in case that the resources are lower than the platform used, for a higher number of frames per second, the Huffman encoding can be eliminated from the coder;
- the quality: the quality can be selected using different matrix of quantization. A library of quantization matrix can be found at [7];
- compression ratio (or the necessary bandwidth): this can be modified changing the quantization matrix or by choosing another coder than Huffman.

VI RESULTS AND PERSPECTIVES

On the motherboard presented in section III of the paper, coder obtained the following results:

- resolution 320*240, color: 5 frames per second;
- resolution 640*480, color: 1.5 frames per second;
- compression ratio: between 32:1 and 140:1 for color images;
- quality for natural images: the quality is variable, depends of the quantization matrix used, but for the one proposed previously in the luminance situation, the PSNR is between 31.2 and 37 dB at the compression ration presented previously;
- bandwidth necessary for 320*240, color: between 10 and 50 Kbytes/s;
- bandwidth necessary for 640*480, color: between 9 and 39 Kbytes/s;

Nowadays, the coder is limited by the technological resources, but for higher prices resources, the number of the frames per second can grow. A better solution, but with high computational costs is to use prediction between frames, and in this situation the compression ration can achieve values higher by 12 times, meaning a compression ratio between 384:1 and 1680:1!

All the results are presented in the most worst cases, only color images, with high details, low resources, thus the results can be even better, depend of the parameters of the coder and the contain of the images.

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AN APPROACH OF DIGITAL CONTROLLERS DESIGN

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Abstract: *This paper presents and uses a modern development technology of data acquisition applications and of digital process control, technology which starts from application modeling and simulation in a virtual software environment and reaches automatic generation of application code for target equipment properly configured. The main objective of this work is the implementation of digital control PID algorithms starting from their SIMULINK model and ending with the functional variant for target equipment compatible with xPC Target specifications.*

Keywords: *design, digital, simulink*

1 INTRODUCTION

The industrial processes automation represents today, more than ever, an activity with significant consequences for the production of material goods. Based on evaluated concepts and technical means, offered by automatics, the most advanced process control technologies can be efficiently implemented. Conceptual evolution in the process control field supported by remarkable progress in microelectronics, made possible the development of high performance digital control systems in which robust control strategies and adaptive and optimal control strategies have become operational. [1]

The design of a system specialized for digital process control is based on the following diagram:

Peripheral equipment used in experiments consist in the data acquisition module (A/D Converter and D/A Converter) and two PCs, the host computer (from where the real time application can be controlled) and the target computer (on which the real time application runs), serially connected.

Local processing includes a user interface that controls the target application, which runs in real time. The application is based on a PID regulation Simulink model, which is compiled and run using xPC Target, Real Time Workshop and a C/C++ compiler.

Supervisor
Presentation
Communications
Local processing
Peripheral equipment

Fig. 1: Hierarchical diagram

Communications – between the target computer, on which the real time application runs, and the host computer can be various types of links:

- RS 232 – serial peer-to-peer connection which assumes limited distance;
- RS 485 – serial multi-peer connection with the MODBUS protocol;
- TCP/IP Ethernet networks.

Presentation – control of application can be done using various environments, as:

- TestPoint – allows development of event based applications;
- MATLAB – includes components like Simulink, Real Time Workshop, xPC Target, components which facilitates modeling, prototyping and real time application execution.

Supervisor – high level which features the following functions:

- identification of the process for which the multichannel numeric regulator will be designed;
- optimization of the regulating process, designed upon performance and robustness criteria (small overcorrection, small transient mode time, stationary error removal).
- elaboration of evolved computing algorithms.

2 THE APPLICATIONS DESCRIPTION

This paper studies the methods of making real time simulations for a MATLAB-SIMULINK model attached to a physical process. [5]

Accent was put on describing the software techniques for controlling a multichannel numeric regulator realized using a PID type algorithm. Simulation is done for the control of a single channel. It can be afterwards extended for all the channels.

In developing a software application, first a SIMULINK model was realized for a closed loop regulator. The next step was the elaboration of a target application using Real Time Workshop, xPC Target and a C/C++ compiler. The target application is loaded on a target computer. The last step is creating a user interface for the remote control of user application. The user interface offers information about the control parameters and output data of the process.

Practical implementations offer the possibility of regulating the reference size and the three components of the PID regulator, the proportional component, the integral component and the differential component, in order to optimize the quality factors of the system. In order to optimize the quality a factor of the system has been introduced the possibility to switch from the automatic operation mode, in which the process is controlled by the PID regulator, in the manual operation mode, in which the user controls the process.

Using SIMULINK, the MATLAB extension for user interface, we realized the model presented in Figure 1. This model does the regulation in closed loop using a PID algorithm. There is also the possibility to switch between the automatic modes, in which the command is taken from the output of the PID block, in manual mode.

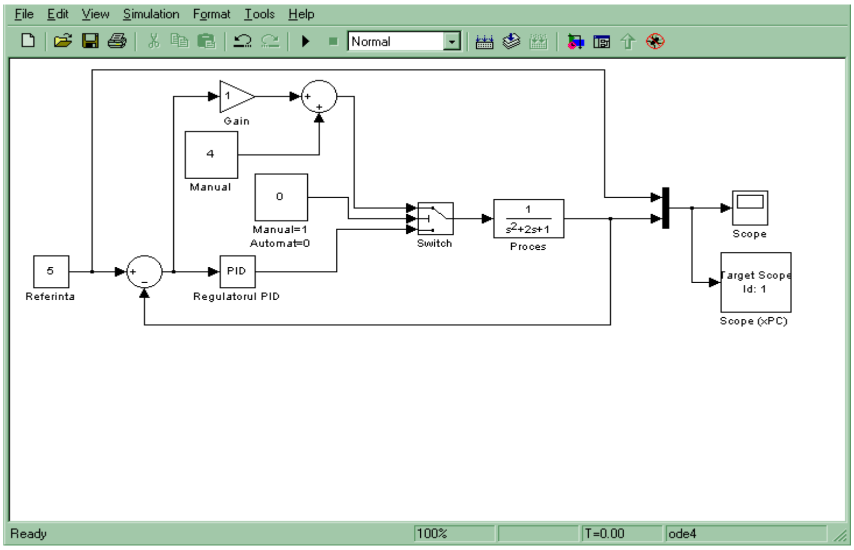

Fig.2: The SIMULINK model

First, we need to mark the signals and parameters of the Simulink model that the user can access through the user interface.

The application on the target computer was developed using the xPC Target, which represents a solution for elaborating prototypes, testing developing real time systems, using a standard PC hardware. It is an environment that uses a target PC, separated from the host PC, for running real time applications.

xPC TargetBox is a target PC of industrial type optimized for the real time execution of code generated with xPC target, Real Time Workshop from Matlab and a C/C++ compiler. This product has extra I/O options. It can be connected to a hardware environment using analog input, analog output, digital I/O, timers/counters or to a medium with CAN buses. This product allows:

- Fast development of a prototype: a controller to run on xPC TargetBox can be designed and the model can be validated without the need for extra hardware.
- Loop hardware simulation: allows real time testing of a controller using simulation equipment that runs on xPC TargetBox.
- Limited development: using the stand-alone way of work, xPC TargetBox can be connected to the equipment and run the test software.

On a host PC, using xPC Target, Real Time Workshop and a C/C++ compiler, executable code can be generated from Simulink or Stateflow models. Using the xPC Target Embedded option, we can use an external floppy unit, or a network connection for:

- loading programs in memory (boot-area) from a flash disk. For this, we must do the following operations:
- transfer xPC Target kernel to a flash disk
- load the kernel to xPC TargetBox.
- load and run the real time application from the host PC.
- running stand-alone applications. We must do the following operations:
- transfer xPC Target kernel and the stand-alone application to a flash disk
- unplug the host PC
- load and run the real time application.

These features make xPC TargetBox the perfect solution for applications needing a high level of processing, low power consumption, flexibility, small size, robustness and resistance to a wide domain of temperatures.

XPC TargetBox is 100% PC compatible and has the following characteristics:

CPU performance: available systems include Pentium II 266 MHz, Pentium III 400 MHz or Pentium III 700 MHz processors. The performance offered by these processors is enough for 75% of the aplications domain.

Memory: A FlashRAM chip is installed directly using an IDE connector and allows booting without a floppy disk drive.

Robustness: xPC TargetBox is protected with an aluminum box with I/O connectors and can work in normal or special conditions without needing extra cooling.

Temperature domain: Special design, for low power consumption, has allowed the removal of mobile cooling fans. There is no need for practicing holes in the box. The temperature domain for standard operation mode is 0^0C – 60^0C. For special conditions operation mode, the domain can be extended for the best models (206 or 207) to -40^0C - 75^0C.

External Floppy Disk Drive: Can be connected to xPC TargetBox using a protected cable. No extra power supply needed.

After marking the parameters and the signals, creating the target application and loading it on the target computer, using MATLAB function *xpcsliface* we created a new Simulink model which contains only the xPC interface blocks (to xPC Target and from xPC Target) defined by the blocks for which we realized the marking of the parameters and signals in the model on which the target application is based. The next step is adding Dial&Gauges interface blocks, which allow regulation of parameters and visualization of signals.

The resulting user interface is presented in fig 3.

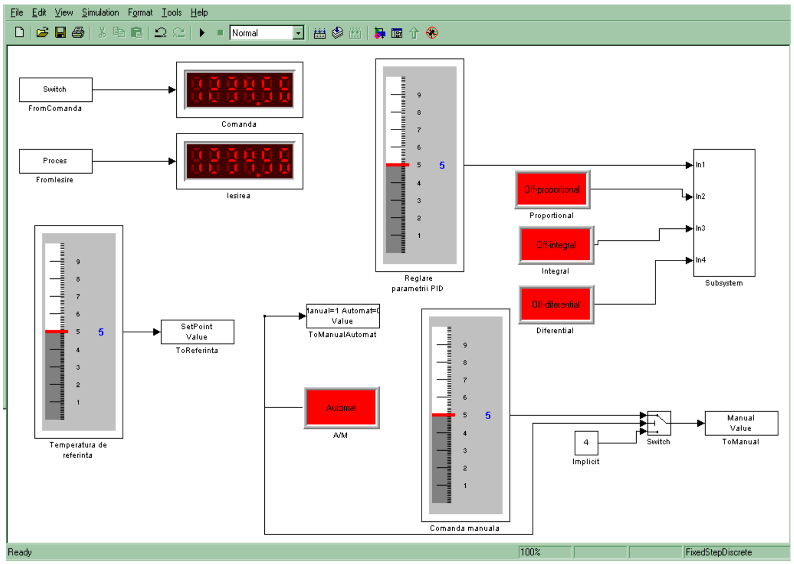

Fig. 3: The user's graphical interface

This user interface model contains:

- numeric display for the variable measured in the program;
- numeric display for the command in the program;
- toggle button for switching from the automatic mode to manual mode;
- three buttons for selecting which parameter of the PID block we correct: proportional, integral or differential;
- a slider for correcting the reference value;
- a slider for automatic correction of the command signal; this slider works only when the toggle button that activates automatic mode is pushed;
- a slider for correction of one of the three parameters of the PID regulator; this slider corrects the value of the PID block for which we have the button pushed.

3 CONCLUSIONS

Designing this kind of applications using the presented technology, which is based on the MATLAB SIMULINK programs package with xPC extension, has the advantage that it assures the possibility of interactive validation of the design specifications through modeling and simulation at all conceptual levels of such an application (local physical equipment, sensors for data acquisition from various types, sending commands for the execution elements used, local processing operations, communication protocols used for integration of local processing equipment in a distributed hierarchical system of monitoring and control, the realization of graphical interfaces for interaction with the human operator at a centralized level and the realization of interfaces with the supervisor level which implements the algorithms for tuning and global optimization of the whole application).

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CONTROL OPTIMISATION AND LOAD PREDICTION FOR MARINE DIESEL ENGINES USING A MEAN VALUE SIMULATION MODEL

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Abstract: *This paper presents some results obtained during a preliminary study into cyclic loading of a diesel engine driving a ship sailing in irregular waves. The diesel engine was simulated using an existing mean value first principle model. Thermal loading prediction was made part of this model. Using the integrated model, two extreme control strategies are compared: constant pitch with a conventional governor and constant speed using a controller for the pitch.*

Keywords: *simulation, engine, marine.*

1 WAVE MODEL

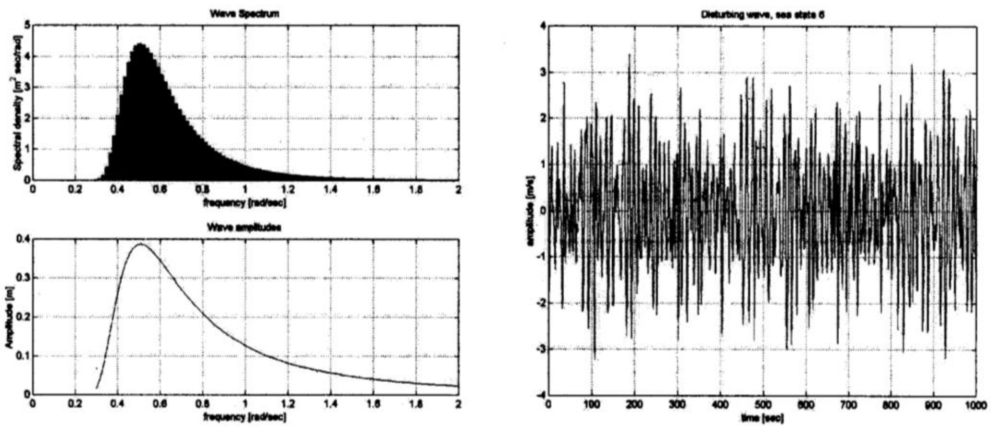
The disturbance of the wake velocity by waves is the most direct dynamic effect on the propulsion plant at sea. The influence of the waves is modeled through time domain estimation from the wave spectrum. The spectrum is divided into small frequency ranges, as shown in the top left graph in Figure 1, which are then translated into individual amplitudes at the average frequency. The wave pattern in the time domain is then derived by adding all these individual wave components together, starting each with a random phase. The time representation of the wave pattern, shown to the right in Figure 1, is used to calculate the disturbance on the propeller entry velocity, which results in a varying propeller load.

2 CONTROL REGIMES

When looking at the general block diagram propulsion plant in Figure 2, it is clear that there are numerous theoretical possibilities for defining control regimes. Even if we limit the control regimes to Single Input, Single Out put (SISO) controllers, many strategies are possible.

As controlled variable, engine or shaft speeds are of course readily available, but also ship speed, thrust, torque or a derived variable could be used. As controlling variable there are only two options: the fuel rack, to determine the power delivered to the propulsion system, or the pitch setting, determining the power required by the propulsion system.

Fig.1: Wave spectrum, frequency distribution and



resulting wave amplitudes for sea state 6.

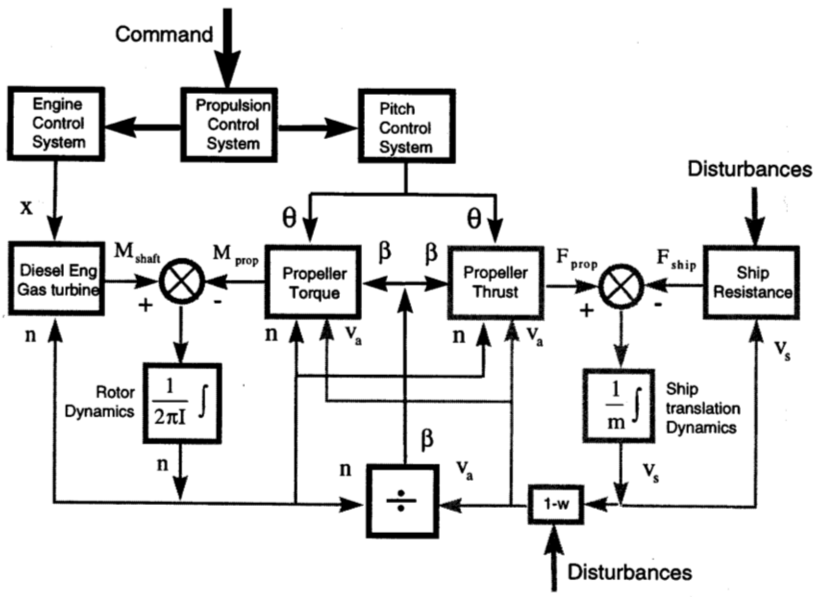


Fig.2: General block diagram of ship propulsion dynamics.

The generally applied control strategy to diesel engine propulsion plants is a fixed engine speed regime, using the governor to control the fuel rack. An alternative could be constant fuel rack operations, but the wave induced load variations are such, that a constant fuel rack will result either in risking an engine over speed or in setting a very conservative fuel rack position. Some control will be necessary to obtain maximum performance. With the CPP propeller the second control variable is also available: the pitch setting. An alternative control regime could therefore be implemented, using the pitch to maintain a constant load on the engine. This is possible through using either engine load or engine speed as controlled variable. The engine speed can still be used, since, at fixed fuel rack, engine speed and engine load are directly related.

Both control regimes are implemented in the model using basically the same controller and limiter algorithms. Thus far, no optimization of the controller was attempted. The aim of the simulations was to create and investigate the boundaries between which all more sophisticated controllers will operate.

When using a CPP, often with the setting of the pitch (or a more generalized control command) the engine speed is also changing, through a combinatory curve. This however is not a „control", since there is no feed back (or feed forward) from the actual plant behavior that influences the chosen set point. It is merely a way to make sure the diesel engine is used to its maximum potential, at a best possible efficiency.

3 RESULTS

All simulations were run starting at 80% of nominal engine speed with 100% pitch, sailing in sea state 6 conditions. After 200 seconds the requested engine speed was increased to 100%, either through a direct command to the governor, or through a new reference shaft speed setting for the pitch controller, accompanied by an appropriate adjustment of the fuel rack setting. Limiters are active in controllers, limiting the fuel injection based on both engine speed and charge air pressure, and limiting the rate of change of the engine speed. It should be noted that the CPP unit used in the model is relatively fast, with a maximum change rate of 2,4° per second.

In Figure 3 the main variables influencing the thermal load on the exhaust valve, and the resulting load indicator T_{ev} are shown. To investigate the influence of the engine and ship dynamics on these variables, also the static values were established, using actual fuel rack and engine speed as input values. These static results are also included in Figure 3. The end cylinder temperature T_6 is clearly estimated too low using the static calculation. Especially during the increase in engine speed (200…250 s), this temperature is underestimated.

The scavenge factor shows a more erratic behavior, were, especially at the lower engine speed setting, the static calculations are overreacting. Using the fuel rack and engine speed directly for calculation of the scavenge factor overlooks the dampening influence of the turbocharger. The overall result shows that the underestimation of the end cylinder temperature prevails in the estimation of the thermal load indicator T_{ev}. Though no quantitative conclusions should be based on these results at this moment, it is clear that the static calculation of thermal loading or of variables influencing thermal load should be done with great care.

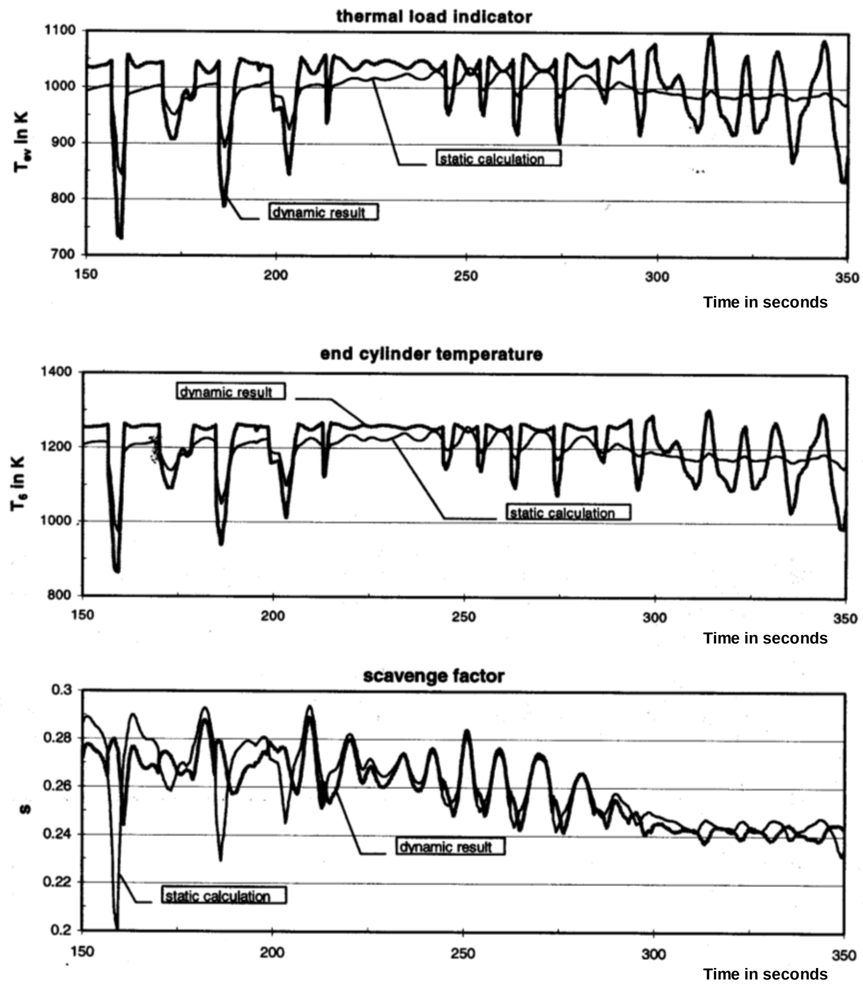


Fig.3: Graphs showing results of both time simulation and static calculations, for end cylinder temperature, scavenge factor and thermal load indicator.

The results also shows the possibilities of the modeling approach adopted here for the diesel engine, to estimate the thermal loads and other complex dynamic phenomena, within a realistically modeled propulsion plant, even including the influence of waves. The fact that variables become readily available that can not be measured in practice is of great importance, for design and research purposes, for problem solving, and for understanding and illustrating the complex behavior of the diesel engine.

In Figure 4 the behavior of the propulsion plant and the ship under the two different control regimes is shown. The two top graphs show the two different controlling variables: fuel rack and pitch. The different control actions of the two controllers counteracting the wave induced disturbances are readily recognizable.

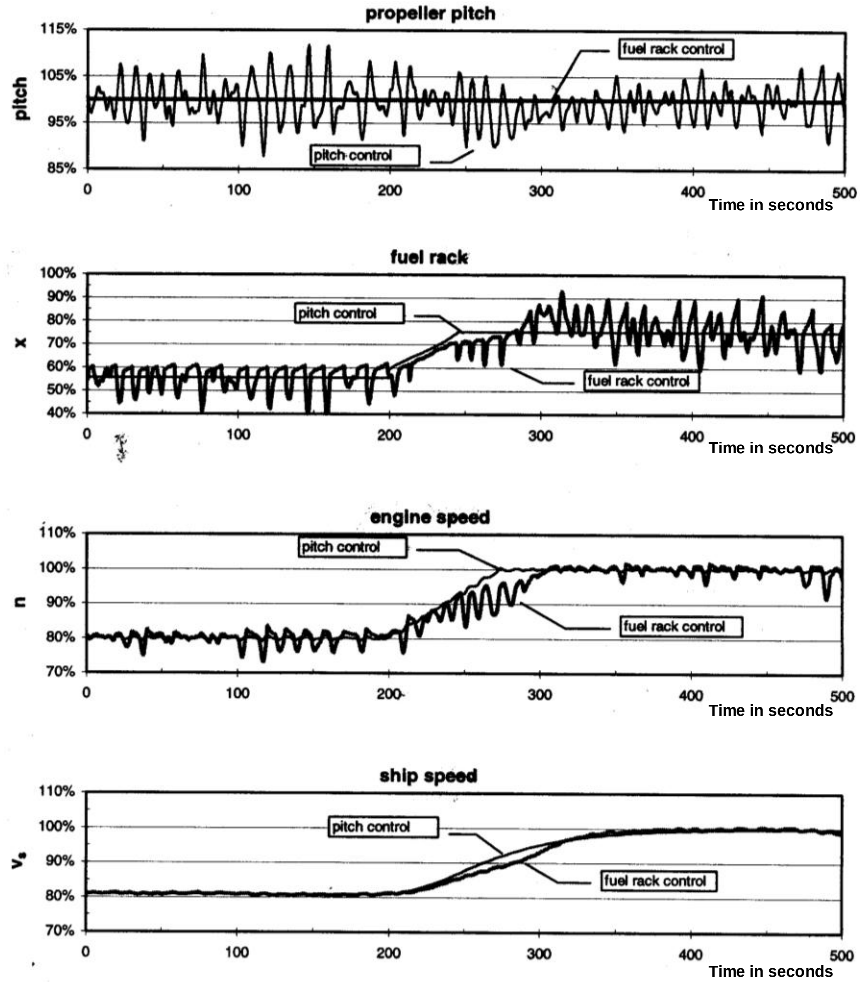


Fig.4: Time simulations showing fuel rack, pitch, engine speed and ship speed in sea state 6, for both fuel rack and pitch control regime. On time = 200 s the requested speed in increased from 80% to 100% of the rated engine speed.

From the engine speed graph it is clear that the pitch controller does a better job in maintaining a constant engine speed. The main reason for this is best illustrated in Figure 2: to maintain a constant engine speed, the fuel rack controller has to adjust the power delivered by the diesel engine through adjusting the fuel flow. The response of the diesel engine is not very fast, especially not the response of the turbo charging system. The pitch controller has a much easier job: changing the pitch instantaneously changes the torque, and in this case, as already mentioned, the changing of the pitch is very fast.

To finalize, shown through the ship speed here, the impact on the behavior of the ship as a whole is limited, as could be expected. Again from Figure 2 it can be seen that any disturbance generated in the propulsion plant has to pass through the ship inertia before showing up in the ship speed, effectively filtering out all higher frequency components. Only during the transient the pitch control renders a slightly better acceleration.

To look further into the consequences this has on the thermal loading of the exhaust valve, Figure 5 shows the charge pressure, again the main variables influencing the thermal loading indicator T_{ev}. Despite the inherent inertia of the turbo charging system, the charge pressure varies considerably under fuel rack control. During the transient, the varying flow through the turbochargers causes the charge pressure to drop behind, thus limiting the acceleration capacity, as seen in the bottom graph of Figure 4.

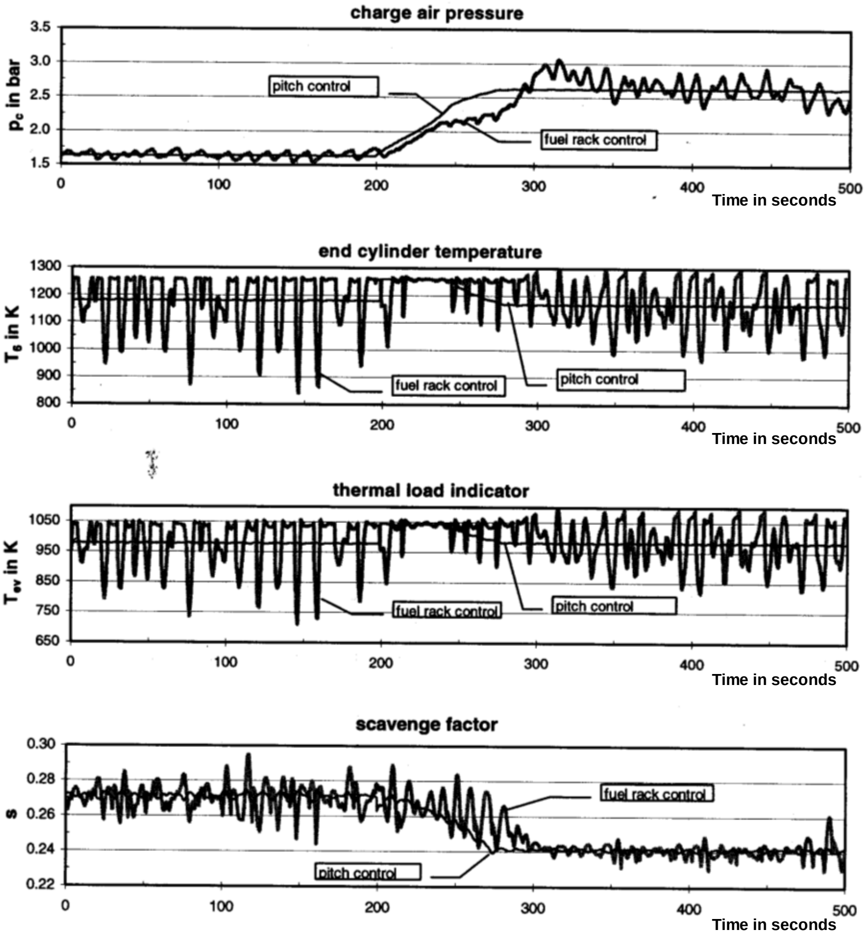


Fig.5: Time simulations showing charge pressure, end cylinder temperature, scavenge factor and thermal load indicator in sea state 6, for both fuel rack and pitch control regime On time = 200 s the requested speed in increased from 80% to 100% of the rated engine speed.

The variations in the cylinder process caused by the changing of the fuel rack directly influence the end cylinder temperature T_6. The graph also shows the charge pressure limiter at work: the high temperature peaks are „shaved" off. The same limiter limits the fuel rack change during the transient under pitch control. The scavenge factor, in contrast with the charge air pressure, becomes more subdued at the higher engine speed. Finally, the graph for the thermal load indicator shows two remarkable differences between the two control regimes: first, the changes in T_{ev} are very large for fuel rack control, and second, the average level is considerably higher.

The adopted pitch control results in a very constant loading of the engine, which is beneficial for the thermal loading. The pitch movements however shown in Figure 4 are quite large and fast, requiring a powerful actuator system. These results are intended to give some reference, as a first step towards an optimal controller, which, by changing both fuel rack and pitch, keeps thermal loads within acceptable limits, while maintaining maximum output or efficiency. Such a controller of course will have to take into account the specific possibilities and limitations of both the engine and the CPP unit.

4 CONCLUSIONS

The aim of the research underlying this paper was to investigate the thermal loading of the diesel engines, under realistic dynamic loads. As often happens with this kind of work, a lot of other interesting questions also arise, such as defining thermal overload in the first place, what is the influence of the adopted control regime, how to correctly model the wave-ship-propeller interaction (fitting within the overall modeling principles applied), what are optimization criteria for a controller, etc. We have shown here some preliminary answers to these questions, indicating the way ahead.

The thermal loading indicator for the exhaust valve defined here shows a good compliance with practical experience: in that especially the speed area between 70% and 90% of nominal engine speed is critical. At lower speeds, scavenging is relatively large, enough to prevent excessive thermal loading, were at higher speeds, the turbocharger provides adequate air to maintain a high air-fuel ratio. Comparing the dynamic simulations with the static calculations shows the danger of adopting static values, and, although in some cases the static calculations give too high (and therefore save) estimates, static calculations should only be used with great care. The simulation models available today can provide more reliable and more detailed answers, and give at the same time a better understanding of the complex interactions between the components in a propulsion plant.

The two control regimes presented here are limit cases. They will be used as reference for the evaluation of Multiple Input, Multiple Output (MIMO) control regimes. In a MIMO approach, both control variables can be used to control the propulsion plant behavior, and optimization choices have to be made. The results from this research will be used to define optimization criteria, both in terms of thermal and mechanical loading and in terms of static and dynamic performance.

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CONCEPT OF DIESEL TURBOCHARGED NAVAL ENGINE MODELING

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***Abstract*:** *This paper shows the flexibility of the chosen modeling strategy it offers to predict the behavior and thermal loading with different control strategies under various conditions.*

Keywords: *naval, engine, model, thermal.*

1 INTRODUCTION

The complex dynamic behavior of highly turbocharged diesel engines maxes control optimization and load predictions often difficult. Especially the impact of controller design on the thermal loading of the engine is difficult to predict, even more so when sea state is to be taken into account.

In particular the combined effect of static overload due to increased ship resistance and dynamic cycling of the fuel rack as a result of wave actions on the propeller can cause prolonged operation in the thermal overload region of the engine. Part, if not cause, of the problem is the governor which tries to keep the engine speed constant for no clear reason, apart from engine protection. Other control strategies are possible, in particular in conjunction with controllable pitch propellers which have the ability to directly compensate any occurring overload by an appropriate load reduction. Electronic controls now being state-of-the-art both for engine and pitch control pave the way for a more integrated approach of the two.

In order to investigate such problems one needs a complete simulation model of the system, i.e. a ship model including the disturbance of waves as well as an engine model that is not only capable of predicting the right torque at the right moment but is able to give answers relating to engines thermal limits as well. The notion of „thermal overloading” is not so unambiguous as one would think and an attempt is made to quantify the thermal overload of the exhaust valve, notably being one of the more critical components in the modern diesel engine.

2 DIESEL ENGINE MODEL

The dynamic model of a turbocharged diesel engine is presented in Figure 1. The big block in the centre of the model is the cylinder model which in fact contains two distinct parts, i.e. the cylinder flow model and the work and heat model.

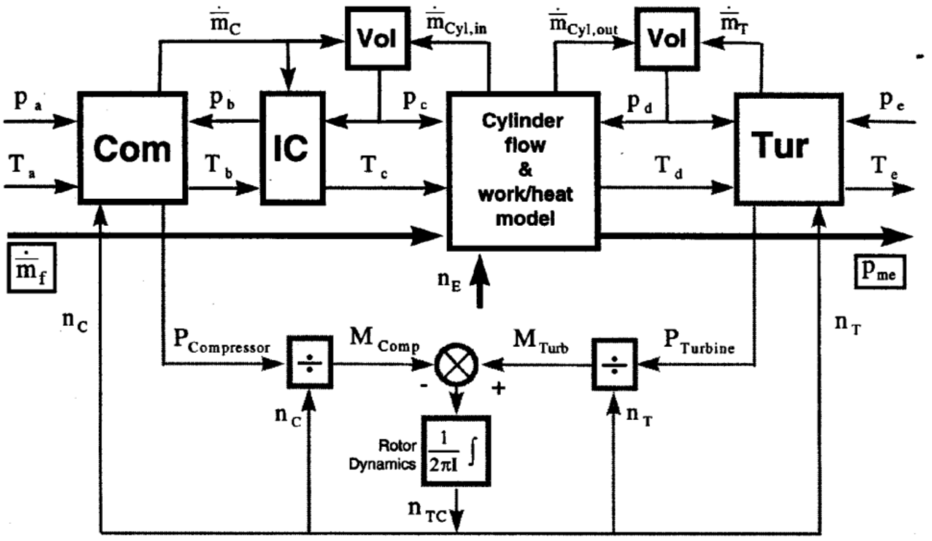

Fig.1: Block diagram of turbocharged diesel engine.

The work/heat model calculates the mean effective pressure (which is equivalent to engine torque) with charge air conditions and fuel flow as input. In simple models mean effective pressure is estimated from fuel flow and air/fuel ratio. One can go one step further and use a standard thermodynamic process (for instance an advanced Seiliger model) and implement this with semi-empirical information of the combustion shape at part load. As an alternative to this method it is possible to run crankshaft angle based simulations with phenomological heat release models to establish the cylinder characteristic in advance and feet these in tabulated form to the block diagram of Figure 1. Finally one could incorporate a crankshaft angle based simulation model of the cylinder process completely into the diesel model. Then however the time scale is much smaller then required for ship propulsion simulation and such models in fact are not suited for implementing into a complete ship model.

Charge air conditions (pressure and temperature) together with engine speed and back pressure determine the cylinder mass flow required by the engine (=demand). Of course a detailed model of the engine swallow characteristic (piston induced inlet stroke and scavenge flow) must be known for that purpose. Given the inlet air temperature and the inlet and outlet pressure of the compressor the delivered mass flow (=supply) is further only determined by the compressor speed (= turbocharger shaft speed). This relation is known as the compressor map and is based on characteristics provided by the manufacturer.

The required mass flow of the engine and the delivered mass flow of the compressor are balanced in a volume element (= inlet receiver). At this point it can be noticed that any unbalance of the net inflow of a volume element will cause the inlet receiver pressure to increase or decrease, i.e. pressure is an output of the volume element. This pressure then, after allowing for the pressure loss over the intercoolers, is fed back to the compressor where is was needed to determine the delivered mass flow. The temperature after the compressor is fed into the intercooler block where inlet receiver temperature is determined on basis of a simple heat exchanger model. So far for the front end of the engine.

The temperature in the outlet receiver follows from the cylinder conditions at the moment of opening of the exhaust. The ultimate outlet receiver temperature however is determined by the blow down process of the exhaust gases and the subsequent cooling of the exhaust receiver gas by scavenge air. A model for the blow down process of the gases in the cylinder down to the pressure in the exhaust receiver always is one of the more intricate parts of a diesel engine simulation model.

Once the exhaust receiver temperature is known, assume that the pressure is known as well (it will turn out that it can be determined on the basis of the mass balance over the exhaust receiver). Since back pressure of the turbine is almost atmospheric the flow that can pass through thr turbine (= demand) further is only dependent on turbine speed (= turbocharger shaft speed). This relation is known as the turbine map and, same as the compressor map, is based on characteristics provided by the manufacturer. The mass flow coming out of the engine (= supply) and forced into outlet receiver simply is equal to the already known required inlet mass flow to which must be added the fuel mass flow (which was an input for the model). Both engine forced exhaust mass flow and turbine determined mass flow must balance in a volume element, this time representing the mass balance over the outlet receiver and resulting in the pressure in that same outlet receiver. To finish the back side of the engine dynamic model the exhaust temperature can be calculated from the outlet receiver temperature and the temperature drop over the turbine.

Last but not least the turbocharger power balance must be modeled. This in essence is a rotational dynamic model as used earlier in the ship shaft system. The compressor and turbine model (with in- and outlet conditions specified and mass flow determined) will be able to return required power of the compressor and delivered power by the turbine. Division by the (yet unknown) turbocharger speed gives the inputs to the turbocharger torque balance. After division by turbocharger inertia the angular acceleration is known and hence by integration the turbocharger shaft speed is known also. This was the only input not yet accounted for.

The engine model as presented is state/of/the/art apart from the cylinder model which will be looked upon in somewhat more detail. The top cycle is modeled using an approximation due to Seiliger and shown in Figure 2. Once the trapped conditions are determined in the gas exchange model and the engine speed and fuel consumption are known, the Seiliger diagram is calculated. This gives the mean effective pressure and the condition in the cylinder when the exhaust valves open (point 6). The 6-point-Seiliger process has six predefined points and five predefined processes:

- Stage 1-2: compression stroke (polytropic process);
- Stage 2-3: constant volume (or premixed) combustion;
- Stage 3-4: constant pressure combustion (and expansion);
- Stage 4-5: constant temperature combustion (and expansion);

● Stage 5-6: expansion stroke (polytropic process).

The seventh point is not a real point of the Seiliger cycle: it represents the condition of the hot gases present in the cylinder prior to scavenging.

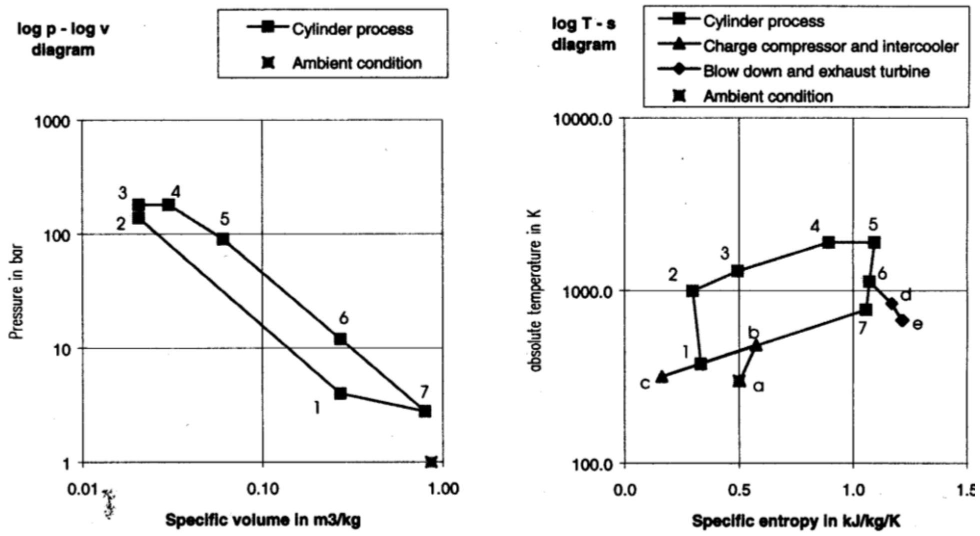

Fig.2: Cylinder process of diesel engine: Seiliger approximation..

There are three characteristic variables in the Seiliger diagram that determine the shape of the combustion part:

$$a = \frac{T_3}{T_2} = \frac{p_3}{p_2}; \qquad b = \frac{T_4}{T_3} = \frac{V_4}{V_3}; \qquad c = \frac{p_4}{p_5} = \frac{V_5}{V_4}. \tag{1}$$

Variables a and b are determined with the conditions in point 2, the engine speed and the fuel consumption. Variable c is determined with the remaining fuel mass after stages 2-3 and 3-4. The advantage of this thermodynamic approximation of the combustion cycle is that internal and external cylinder conditions are calculated with reasonable accuracy, without the need for a detailed model of the cylinder. So in all its simplicity the model not only is able to predict the time evolution of the torque but it can also answer questions as what parameter values existed in the cylinder during that time evolution, e.g. air excess ratio λ in the cylinder, maximum cylinder pressure and temperature p_{max}, T_{max}, idem but values at moment of exhaust valve opening p_6 and T_6. So in principle it is possible to make statements on the correlation between control of the propulsion system and the exceeding of engine limits.

3 ENGINE OPERATING ENVELOPE AND LIMITS

A diesel engine in general, but highly turbocharged engines even more so, have limitations with respect to the operation in the power/speed characteristic, refer to Figure 3.

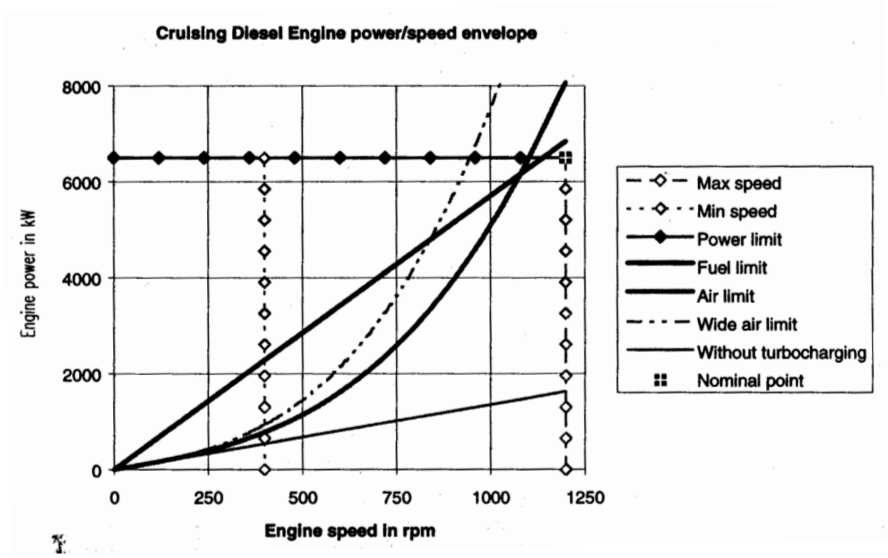

Fig.3: Limits in the characteristic of a modern turbocharged diesel engine; wide air limit applies to sequential turbocharging or variable geometry turbine (VTG).

The limits are as follows:

● First there is a maximum speed for which the rotating and translating parts (pistons, connecting rods, crankshaft but also the valves with their actuating mechanism) are designed. The governor of the diesel engine monitors engine speed and reduces fuel as soon as overspeed tends to occur. Above a certain limit an emergency stop will be initiated (fuel to zero). A diesel engine also has a minimum speed: below a certain speed the engine will not run smoothly or even stop altog. This is caused by loss of compression and as a consequence failure of ignition. Minimum speed normally is 30% to 40% of nominal speed.

● There may be a small speed range where maximum power can be delivered.

● Below this „maximum power window" the power of a diesel engine is limited by the maximum fuel injected per cycle. If overall efficiency does not vary too much the mean effective pressure is proportional to injected fuel:

$$p_{me} \propto m_f . \tag{2}$$

So maximum fuel implies maximum mean effective pressure which is equivalent to maximum torque and shows in the power/speed characteristic as a straight ine to the origin.

● For a turbocharged diesel engine below a certain speed even maximum torque cannot be achieved anymore. The reason is that the lower engine speed causes a lower exhaust flow. The turbine pressure then falls rapidly and although exhaust energy (= temperature) is still high the turbine cannot deliver sufficient power to the compressor and the charge pressure drops. The available mass of combustion air („*ca”*) in the cylinder is proportional to the charge pressure, i.e. according to the gas law:

$$m_{ca} = \eta_{trap} \cdot \frac{p_c \cdot V_s}{R_a \cdot T_c}. \quad (3)$$

So the amount of air in the cylinder drops togheter with the charge pressure. When the amount of injected fuel per cycle is maintained the air/fuel ratio will drop and the air excess may become insufficient:

$$\lambda \stackrel{def}{=} \frac{m_{ca}}{\sigma \cdot m_f}. \quad (4)$$

This causes the temperatures, in particular the exhaust temperature to become (too) high, i.e. thermal overload of the engine. Also the compressor may surge resulting in a sudden further drop of charge pressure. The net result is a „forbidden area”, well below the maximum torque line. There is no internal mechanism that prevents the diesel engine from entering that thermal overload area, causing damage in case of prolonged operation. Often a charge pressure related limiter on the fuel rack position is incorporated in the governor, but this is not present on all diesel engines.

● Mean effective pressure and thus torque are proportional to charge pressure. In case of no turbocharging the mean effective pressure of any diesel engine would be around 6 bar. This is shown in Figure 3 as the line „without turbocharging”. As argued above at low engine speed the turbocharger is hardly operating, therefore the air limit is always tangent to a torque line corresponding to a mean effective pressure of around 6 bar. Then it will be clear that the gap due to the air limit is deeper for highly charged engines with mean effective pressure of 20 bar or higher. The problem really becomes severe in case of very high charge pressures (5 bar) with corresponding high mean effective pressure (30 bar) for which two stage turbocharging becomes necessary. Of course the problem may be alleviated by adopting sequential turbocharging or even variable turbine geometry.

4 THERMAL LOAD PREDICTION

In the previous chapter we have seen that prevention thermal overload in case of high torque and lower than nominal speed is major challenge for any control system. Before making quantitative statements on thermal (over)loading of the engine the notion „thermal overload” must be clarified. Thermal overload can be associated with a lot of parameters, not all of which can be measured in an actual engine (but in a simulation any quantity can be measures):

● air excess ratio in cylinder (λ);

● charge pressure in relation to fuel injection (in fact an estimator for air excess ratio in cylinder);

● ratio of total/in-cylinder air excess ratio (or through flow factor $l{+}s{=}\lambda_{tot}/\lambda$);

● maximum temperature in cylinder (T_4);

● cylinder temperature just before opening of the exhaust (T_6);

● gas temperature directly after exhaust valve (often measured on actual engines);

● exhaust receiver temperature (before turbine: T_d);

● gas exhaust temperature (after turbine: T_e).

But in the end any damaging effect from thermal overloading must be caused by a (too) high temperature of material parts of the engine:

● cylinder wall temperature;
● piston head temperature;
● cylinder head temperature;
● exhaust valve temperature.

As an example we will concentrate on the exhaust valve temperature. The exhaust valve is thermally loaded during blow down when the valve is not cooled by its seating and heat transfer of the hot gases to the valve body is good. Modern turbochargers however make it possible to maintain a good scavenge flow during an extended scavenge period of 80 to 100 degrees crank angle in stat-of-the-art 4 stroke engines.

To predict the thermal loading of the exhaust valve from the model described in the previous section, some additional calculations are needed. The exhaust valve temperature is thought to be a result of heating up during blow down with gases at a temperature of the order T_6 and cooling during scavenging with gases at a temperature of approximately T_1:

$$T_{ev} = \frac{T_6 + r \cdot T_1}{1 + r}. \tag{5}$$

The factor r defining de equilibrium is dependent on the heat transfer mechanism and is shown to be mainly dependent on the scavenge factor s:

$$r = s^{0,8} \cdot \left(\frac{T_1}{T_6}\right)^{0,25} \cdot \left(\frac{EC - IO}{IO - EO}\right)^{0,2}, \tag{6}$$

where: EC – exhaust closes; IO – inlet opens; EO – exhaust opens. The scavenge factor is the ratio of the mean mass flow that goes through the engine during scavenging (and thus is available for cooling of the exhaust valve) and the mean the mass flow that passes the exhaust flow during blow down (almost equal to the mean mass flow required for combustion). Furthermore r and thus the thermal loading of the valve proves to be feebly dependent on temperature and also on the ratio of the crank angle available for scavenging and for blow down.

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EFFECTIVENESS OF THE NAVAL DIESEL ENGINE FUNCTION AT THE TRANSIENT STATES OF SPEEDING

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***Abstract**: From the big number of transient states what characterize the function of a naval diesel engine, the state of speeding is the most studied at this moment. For the effectiveness of the function, the designer specialists, constructors but also those who repair, exploit and care the naval diesel engines, must collaborate permanently. This effectiveness is becoming possible ensuring a higher and longer dynamicity for engines, with a small specific consumption of fuel and a reduced grade of environmental pollution. The very high level of quality in the production of engines reached by the powerful enterprises in domain („MAN B&W”, „Sulzer”, „Gotawerken”, „Wartsilla”, „Detroit Diesel Motor” etc.), the performant equipments of command, watching and control of the function, combined with the profession of the crew, will contribute, certainly, to the effectiveness of the naval diesel engine function.*

Keywords: *Engine, naval, gase.*

1 GENERALITIES

Engine’s state of function where upon the speed, the torque and the temperature fluctuate continuously in time its naming „transient” or “unstationary”.

For the rating of the engine’s transient state of function, is looking fluctuation in time of one of the following parameters; bent axle speed, process time, effective power or effective torque.

The most distributed states are “transient state” who commence at one stationary state and they finish to another stationary state [2].

From the multiple forms of transient states, the most important are those who are depending by the energetical, economical and ecological performances.

These states are called determinant states and they are usually connected by the fuel debits variations. To study the progress of different phenomena that appear in engine during the transient state, must be done the comparing with the parameters that describe its function at transient states.

2 PARTICULARITIES OF NAVAL DIESEL ENGINE FUNCTION AT TRANSIENT STATES

For the ship's engine, the transient state of function is generally uppermost because the ship speed and the engine's load in very large limits depend on the navigation condition, weather conditions, missions etc. Automatically, engines speed will be variable. In the case of propulsion engines, there are speeding transient states, rotation state, transient states for passing to a characteristic of the propeller to another etc.

At the transient states it is possible that the naval diesel engines might work at a position of the injection pump rack and to a speed of bent axle specific to a determinant stationary state to the speed characteristic or to the propeller characteristic [5].

The expanded moment the engine on the transient state time depends decisively on the preparing way and the progress of the work process from the cylinders, simultaneous with the power required by the consumer.

3 EQUIPMENTS FOR FUNCTION EFFICIENCY OF NAVAL DIESEL ENGINE AT TRANSIENT STATES OF STARTING AND SPEEDING

A way to measure the concentration of NOx, NO2, N2O by catalytic conversion is the disposal on the route of exhaust gases of one apparatus which function by the principle of photometry (ultraviolet radiation) and could be equipped with this semifast engines and low speed engines [3].

German company "BMW" is very preoccupied in introducing (for his production of automobiles), these disposals (see figure 1) of reducing the concentration of NOx from exhaust gases with under 50 mg/Nm3 (it is a value established by the standards of U.E. – "EURO 5") and HC and CO (in this way they are collaborating with the American company "Borg Warner").

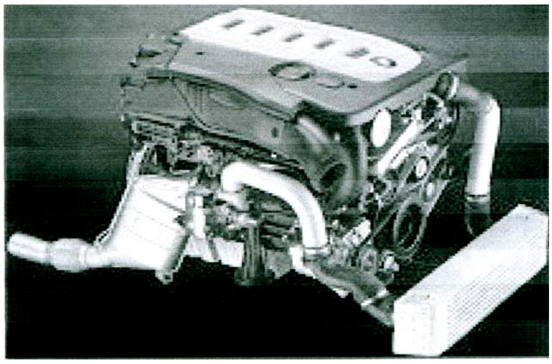

Fig. 1 Disposal of reducing gases from exhaust gases of the engines

In the moment of starting the engine, emission of gases is increased. To reduce the emission, must be perfected the methods of starting the engine. In this way, company "Mann & Hummel" has developed a technology of supplementary injection of air in cylinders (see fig. 2) as an adjacent source of supercharging (electro charger) or for increasing the value of air pressure at starting (booster) for the starting to be easier.

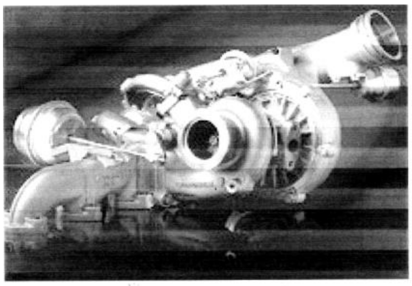

Fig. 2 Disposal of supplementary injection of air in cylinders

Supercharging with two turbochargers, preferably with variably geometry (see fig. 3) and equipping the engine with SCR and EGR (device which auto sense the injection reducing and action for optimization the quantity of air/fuel in the cylinders) are another two ways to improve the function of naval diesel engine.

4 MONITORING THE GASES AT THE DIESEL ENGINE

Specialist's attention is centered on the emission of exhaust gases.

The normative which monitors and sanctions maritime economical activities is Annex 6 of IMO, who includes efficiency standards. German company "MAN B&W" has perfected methods (accepted by the Societies of International Classification) who reduce gases emission from the exhaust [6].

The authorities attention is focused on the reducing the concentration of NOx and SOx but Annex 6 says that should be in attention also the concentration of HC, CO, CO2 and particles. Gases emission composition from the exhaust of a diesel engine is related in figure 4.

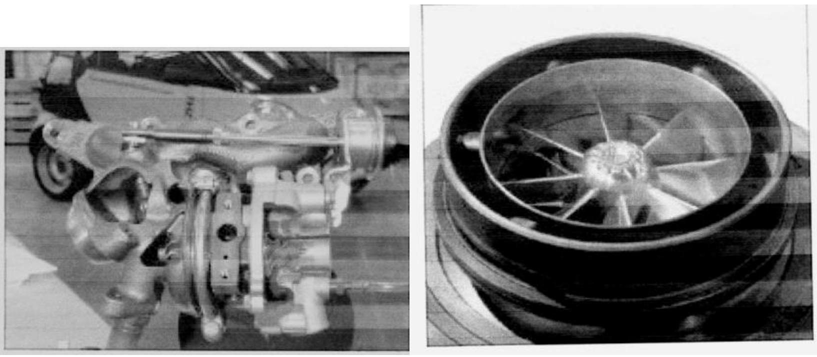

Fig. 3 Engine supercharging with two turbochargers with variable geometry

From what we can see, the biggest concentration (who is the most dangerous) is the NOx. The specialists have developed primary and secondary methods of reducing the concentration of gases. By the primary methods is prevented from the source, forming of pollutions like NOx, SOx, HC, CO, CO2 and by the secondary methods are reduced gases already generated by the engine.

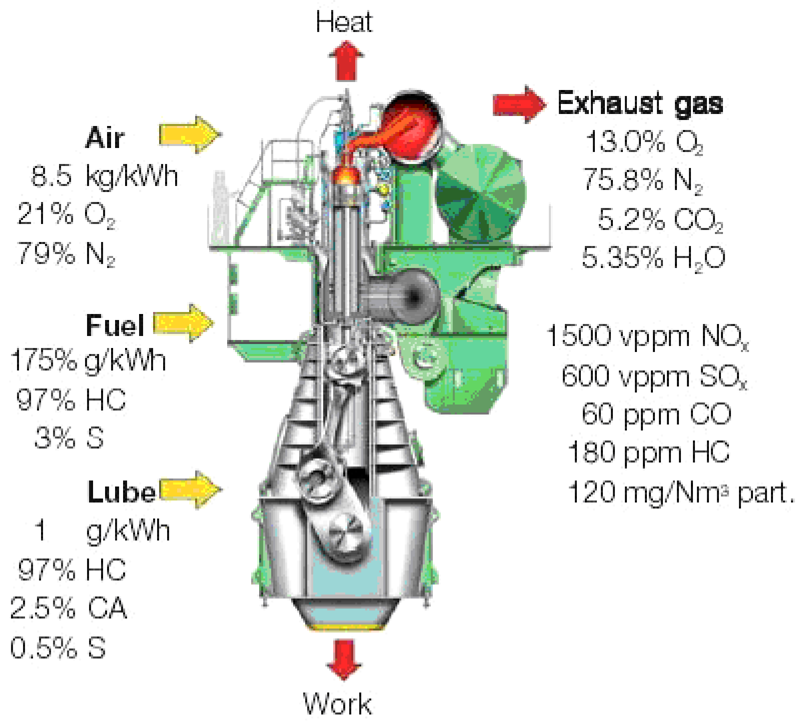

Fig. 4 The composition emissions of diesel engine exhaust gases

Primary methods of reducing the gases:

B1. Injection optimization control;

B2. Particles emission and evacuation smoke evaluation;

B3. Monitoring the HC and CO2 concentration from the exhausted gases of the engine.

B1. Injection optimization control

In this way there are constructive ways of control in the problem of how the injector work by reducing the volume of nozzle and vertical disposal of the nozzle needle (see fig. 5), simultaneous with the symmetrical disposal of the nose pipes. In this way, is reduced the probability of no oxidation of the hydrocarbons from the fuel mixture, but increasing the energy developed by ignition.

B2. Particles emission and evaluation of the smoke during evacuation

Evacuation smoke contains in a significant proportion NO2 and particles when the color is yellow-brown in the gases that contains also water vapors.

Main sources of the particles emission from the exhaust gases in atmosphere are:

- concentration of little particles resulted from incomplete ignition of the fuel mixture on evacuation;

- ignition and transformation in particles of one part from the greasing oil;

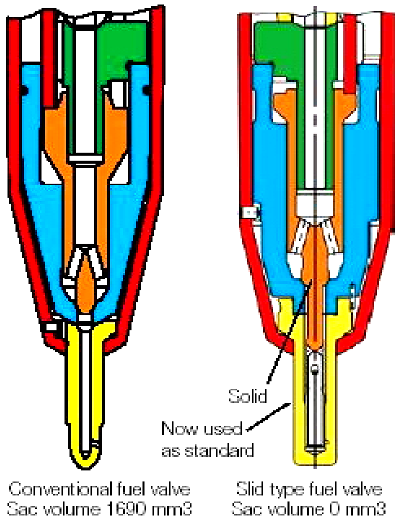

Fig. 5 Injection optimization control by reducing the interior volume of the nozzle

- percent of ash that exceed 0,009 mg/l of fuel or oil, from the engine;
- fuel exceed values of 0,025 mg H2O and 0,2 mg sulfur.

This particles, which have dimensions over 1 micrometer, are removed from the exhaust gases before they are being evacuate in the atmosphere, with the help of deterrent (see fig. 6), because they are very toxic.

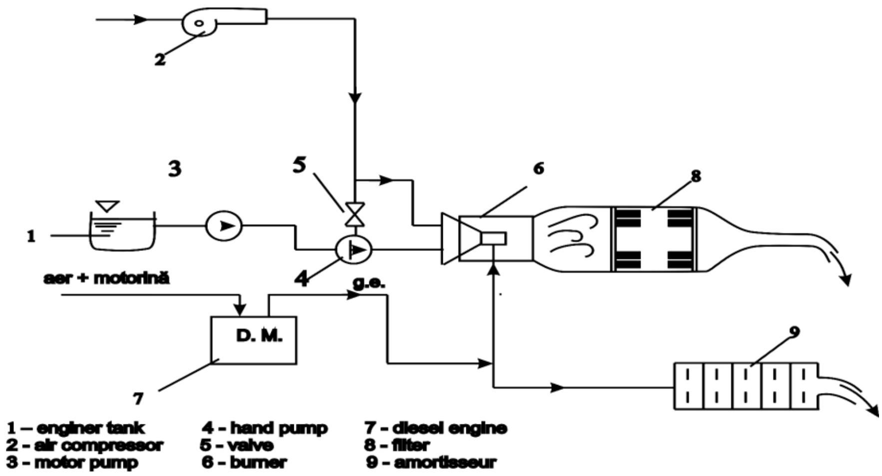

Fig. 6 Deterrent who equips "BMW" engines

B3. Monitoring of sulphur, HC and CO2 from the exhaust gases of the engine

Sulphur from the fuel is decisive in generating SOx, SO2 and particles from the exhaust gases. Inferior quality of the fuel results a higher quantity ignited in deterrent, proportional with the concentration of particles and SO2 from the exhaust gases. Referring at the HC concentration, this is reduced by function optimization of the disposals that are in the injection equipment (see fig. 7).

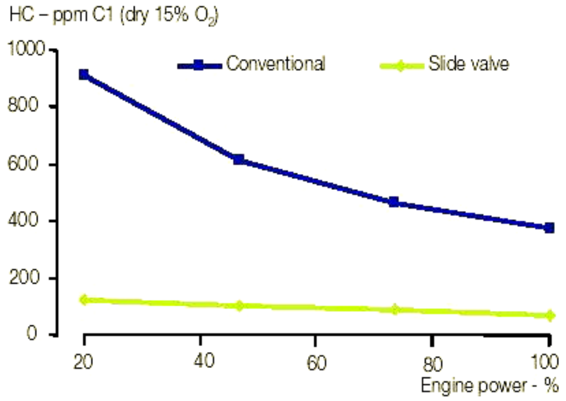

Fig.7 Reducing HC concentration by function optimization

If sulphur concentration from the fuel is under 1,5 %, then toxic emissions are reduced. It is the case of Nordic states (Sweden, Norway, Denmark, and Finland) who adopted a special code in this way to prevent increasing sulfur concentration over 2% (see fig. 8).

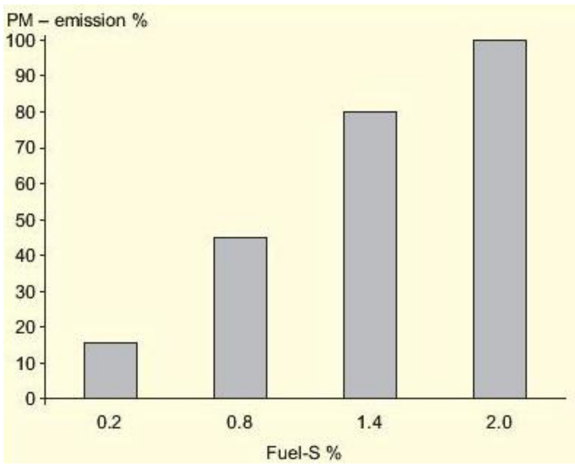

Fig. 8 Particles concentration reported to the sulphur concentration

Particles emissions from exhaust gases is also generated by the gapping and the quality and quantity of oil from the engine parts; if these are not correct, oil consumption is increased, which determinates increasing particles concentration from the exhaust gases of the engine.

German company “MAN B&W” equipped greasing system with “Alpha Lubricator” electronic disposal, which monitors with a high precision, oil pressure in installation and the gage of the oil, so the consumption to be optimized. With this disposal oil consumption is under 0,5 g/CPh (see fig. 9).

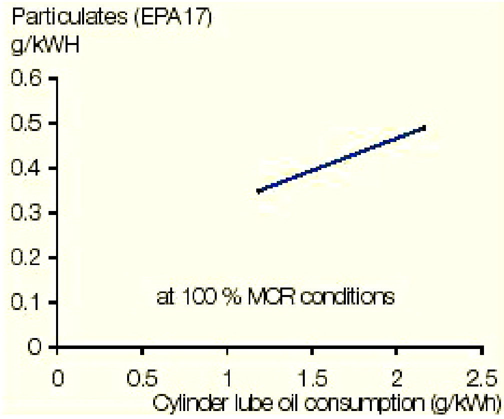

Fig. 9 Particles concentration reported to the greasing oil consumption

CO2 emission in atmosphere by exhaust gases must be reduced because it have negative effects; an alternative to reduce this emissions under 30% at the ships with diesel engines and with superchargers, is to use instead of diesel fuel LNG. (see fig. 10). Counts present a economy of 3,5 billiards USA per year, for one ship.

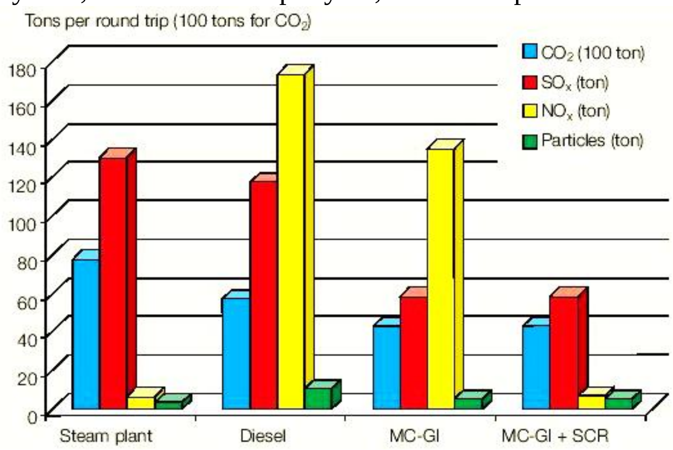

Fig. 10 Noxe emissions when are ignited for propulsion LNG

5. CONCLUSIONS

1. The research work and practical experience showed that are enough reasons for reducing the emissions.

2. First option is introducing the modifications for adjust the engine, we go to a 30% reducing of noxe emissions, instead the engine built in ´90. For the future reducing the direct injection of the water is considered the best solution. On the test banc, this technique proved that NOx level is reduced by 60% instead the standard engines.

3. For a NOx level reduction with 90% or more, the supplementary treatment with SCR devices way an efficient solution even it was used fuel with lot of sulphur.

4. SOx reduced emissions are realized by using fuel with a little quantity of sulphur. The process of desulphurization has a problem of storage, and that is not accepted on the ships.

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SPECIAL VEHICLES MADE IN THE STUDENT AND PROFESSOR'S PROJECT TEAMS, AT MECHANICAL ENGINEERING FACULTY – "OVIDIUS" UNIVERSITY OF CONSTANTA

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Abstract*: The paper presents the three generation main achievements of the student and professors' team that projected, built, tested and launched, in 19 May 2007, the TRIO City Car Concept- as a 2,5 meters long / three seats / Flexi Fuel prototype-. Some aspects of NEMO history (first floated car that sailed across Mamaia Lake in June 2005 and future MIXTRA (Mixed Transport On road and water) experimental projects are also part of the presentation. The work reveals some main projects realized during practical and training activity in Constanta "Ovidius" University Automotive Engineering Section.*

Keywords: *project, vehicle, trio.*

1 INTRODUCTION

The whole thing began when we have decided to create our own workshop for our specialization's practical activities. Our colleagues from the first generation of Motoring graduates identified together with the coordinators of the Motoring and Road Vehicles Specializations potential projects.

From old, almost forgotten cars we, the Road Vehicles students, made the first "school- cars".

A fated link of words between our jointed passion for cars and willing to learn. By special efforts we brought them back to life and proudly shaped them according to our wishes… three Dacia, four Dacia Lastun, two motorbikes, two motor bicycles, one truck, all team-worked, all being complex projects that meant hundreds of working hours. Because of the countless obstacles that we had to deal with, the teachers, specialists and sponsors from the business environment stood there by us.

As we acknowledged that dreams could come true we decided that "Nothing was impossible for our team"… and there was born "Nemo", the first floating Dacia which crossed the Mamaia Lake in the applauses of hundreds of fans that wanted to feel the "taste of success"…The two colleagues, leading actors of the event became stars and proved that the whole teams' dreams can fulfill even since the years of studency.

One of the motorbikes has been transformed into a tricycle….*Romanian Sun Dust Motor Bike*, project that we are still working on and which, being forwarded over the generations is redesigned and updated until is going to be finalized into a different concept.

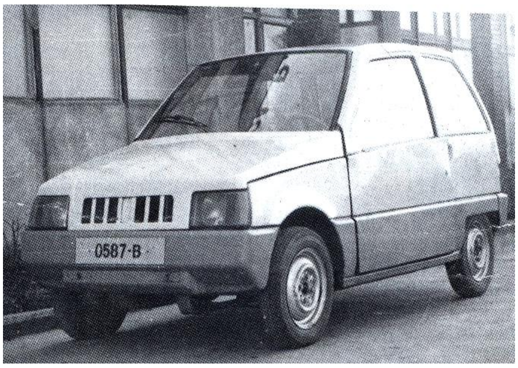

Fig.1 Dacia Lastun - First Romanian City Car

The contest of the teams that had to obtain the most performing *Lastun* City Car Recovery was a success. The winning car got the right to be retained on the dynamic research stand…where we and the next generations will create a virtual lab for learning how to drive safely on the "routes of our life" …the Lastun, last placed in the contest, became the foundation of the project called TRIO.

The New Trio- The Last Lastun.

2 THE STORY OF THE CITY CAR TRIO

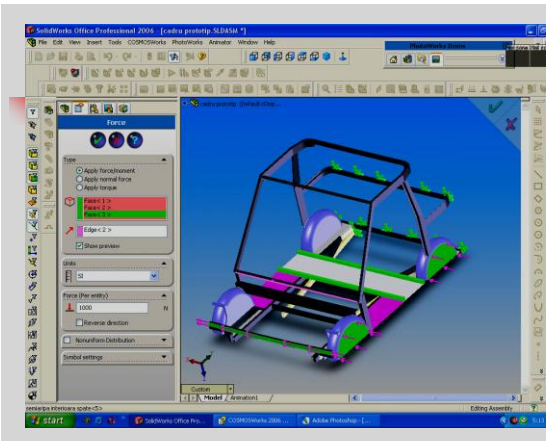

Fig.2 TRIO-Engineering Design

The story of the city car Trio, developed in Constanta, started with the objective which proposed the reworking as a team to a new Lastun. Maybe you remind yourselves, that the first 100% Romanian car Lastun designed and created in the worst conditions by the ones that were desperately looking for a way to show the real capabilities of the Romanian Motoring School. If thousands of Romanian specialists who have contributed to the development of the Lastun car using their energy and knowledge, have been rejected by the cruel transition that smashed dreams, projects, industrial plants up, then were we entitled to hope?

Fig.3 TRIO- Design Concept

We have gathered together teachers, engineers, graduates, undergraduate or part-time studies students and all have decided that we have had to start the project on.
Over three hundreds of students have worked during the three years on. Practice probation time, license and graduation projects, days, nights and much hope. Based on a structure calculation and taking the subsystems from the serial production of the Romanian plants over, the project was outlined: 2,5 m length, 1,90 m width, 1,40 m height, 3 places on a single front-row. The steering wheel placed in the middle or on the left side…discussions, analyses….Safety based discussions…on the left…capacity…prototype engine INAR Brasov- Brasov Transilvania University (the one who was already prepared for the real “Lastun”)…yes…but in the meantime the National Road Vehicles Institute – INAR Brasov, other great research center in the Thermal engines field was disappearing in the storm of transition and the motto propulsive unit never been sent to us…What should we do?…We are going to adopt a small capacity engine like Daewoo Tico…The Motor Industry existed in Craiova too and the plant could be able to sustain this kind of capacity.

Fig.4 TRIO-First Steps.

Fig.5 TRIO - practical approaches

We have found in Constanta the spare-parts: engine, gear-box, we have changed the placement of the moto propulsive unit, the planet gears, steering and breaking systems…all carried too slow for our needs out…we redesigned and checked everything again out and after that, with the support of RATC Constanta (which adopted us among the last project’s steps), we made it.

Fig.6 TRIO-in front of the “Ovidius” University

Our partners from Cardinal Motors devoted themselves to the final stage of the exterior aspect…and what can be more beautiful: the project has been coordinated by our former colleagues, the past time students who have initiated the project now recognized specialists at their jobs…they are the ones that made an exceptional lobby for us to the investors who now confirm their will to get involved in our projects…The “Mircea cel Batran” National College from Constanta, european well-known college, through one of its remarkable pupils (Mihai Caranica from the 10th form) initiated the 3D design of the TRIO prototype…We have managed in fact to insert together within a big caps TRIO all the hopes of the pupils, students and the motoring high education, a research team’s objectives and the expectations of the economic environment…

F

Fig.7 TRIO-in front of our Automotive Engineering Amphitheater at the “Ovidius” University

A TRIO propulsed by an engine that can be fueled with gas, GPL and ethanol in the future.

The business and the academically environment promptly responded to the project the excelency prize at the national Sesion of the students scientific dissertations.- The naval Academy 2007, 1st prize at the Maritime University in Constanta and essays at the Inventions Contest in Iasi. Sponsorships on behalf of Cardinal Motors and RATC Constanta for the studies trip.

The team revived the success of NEMO 2005 project. The promotion of our beloved specialization, faculty and university has reached its target out…the new generations of pupils found out the place where are trustfully waited for and they can gain their winning skills in.

At the same time the other teams of students have renewed the future lab prototype of the motorists and the University board, responsive to our constant efforts has supported us in building, from its own funds, a specialized labs and lecture rooms unit…Which way the students have been involved in the labs endowment during a time with difficulties in gathering the funds centrally?

This is a whole other story…happy-ending…which is still taking place these days: performing computers, assisted software licenses, breaking stands (rebuilt and assembled by the students), these are only bits of the scenario revealed on the spot. In the mean time we organized rally contests where students try to put in practice in force driving skills.

The new lecture room (Fig.10) that receives the lectures of our teachers gathers and transmits further the emotion of the students that for the first time step in and few years later become specialists, enhancing over the years the meaning of the words:

Fig.10 Autotehnica Automotive Diagnose Technical Fair organized at “Ovidius” University of Constanta in may 2007

“There is nothing impossible for our team”- our logo *that asked for standing by us all those eager to have mind, heart and will to know.* That is why, in December or in the next spring we invite you to be at the launching day of our future MIXTRA Prototype (Fig.11)…next time to tell you about.

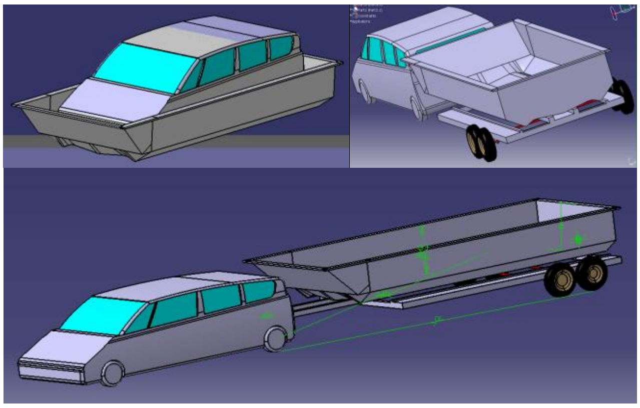

Fig.11 MIXTRA Concept

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A STUDY OF THE DYNAMICS FOR ONE HYBRID VEHICLE, AUTOMOBILE-SHIP, WITH SUBMERSIBLE LIFTING WING

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Abstract: *In this paper it is presented original contributions at the analytical definition of the dynamics for one hybrid vehicle, automobile-ship, with submersible lifting wing, in the case of soil running and water floating, in stationary and transitory movement. The study permits the determination, in any functional regime, of the movement components (cinematic measures: velocity v, acceleration a, road length l, time t, and dynamic measures: fluidic forces of head and lifting resistance, necessary power). It is assessing a transition function: relative velocity, dimensionless, in function of the relative time. The showed relations allow the numerical resolve of some constructive solutions and their energetic optimization.*

Keywords: *submersible, automobile, ship, hybrid.*

1 INTRODUCTION

In [1] is presented a prototype of a hybrid vehicle named Rinspeed Splash. The almost magical transformation from a street vehicle into a floating and 'flying' all-rounder is made possible by an electronically controlled hydraulic system with an array of sophisticated sensors. The transformation starts with the nondescript rear panel, which flips up to reveal a Z-drive in horizontal rest position, borrowed from a watercraft. The Z-drive is fitted with a conventional 3-bladed propeller and can be lowered to its fully 'standing' position from the cockpit. The position of the drive is infinitely variable, which guarantees immediate propulsion upon entering the water. A custom-designed transfer case sends power to the rear wheels, the propeller or both, depending on the input from the pilot. Starting at a water depth of about 1.1 meters the Z-drive can be lowered all the way to its fully 'standing' position. Steering commands are entered via the steering wheel and transferred to the Z-drive. At a minimum water depth of about 1.3 meters the pilot can deploy a highly complex system of hydrofoils integrated into the sleek body of the "Splash". The Formula-1 type rear spoiler rotates 180 degrees down and comes to rest below the "Splash." To the left and right of the high side walls of the cockpit two hydrofoils integrated into the outside skin rotate 90 degrees to point straight down before unfolding into their lifting V shape.

Fig 1. Rinspeed Splash hybrid vehicle

The angle of attack of each hydrofoil can be adjusted individually by the pilot to account for the various operating states. Already at low speeds the vehicle begins to lift itself out of the water. The fully suspended position can be reached at speeds as low as 30 km/h. The unusual vehicle then travels as a true hydrofoil at an altitude of about 60 cm above the water. Even the wheels are free of water contact. On smooth water the “Splash” is capable of reaching a top speed of about 80 km/h.

Naturally the “Splash” can also be operated as a ‘conventional’ amphibious vehicle. With retracted hydrofoils the “Splash” reaches a top speed of almost 50 km/h. That is fast enough for water skiing or knee boarding.

The body of the “Splash” is designed to be watertight. Additional buoyancy chambers provide extra lift. Also borrowed from shipbuilding are a bulkhead design with independent chambers and bilge pumps – in case some water does find its way into the cockpit or the engine bay. Fourteen rubber bellows guarantee freedom of movement of drive train, suspension and steering.

2 THEORETICAL CONSIDERATIONS

The normal force to the ground of the vehicle is:

$$F_N = m \cdot g \ \ [N] \tag{1}$$

where m·g is the vehicle weight.

The road resistance force (horizontal), of coefficient C_r is:

$$F_r = C_{rl} \cdot F_N \ \ [N] \tag{2}$$

The aerodynamic head resistance force of the vehicle, of coefficient C_x is:

$$F'_x = C'_x \cdot A' \cdot \frac{\rho \cdot v^2}{2} \ \ [N] \tag{3}$$

Where:

A’ $[m^2]$ – the maximum cross-section area;

ρ $[kg/m^3]$ – the air mass density;

$\frac{\rho \cdot v^2}{2}$ $[N/m^2]$ – the impact dynamic pressure;

v [m/s] – the velocity.

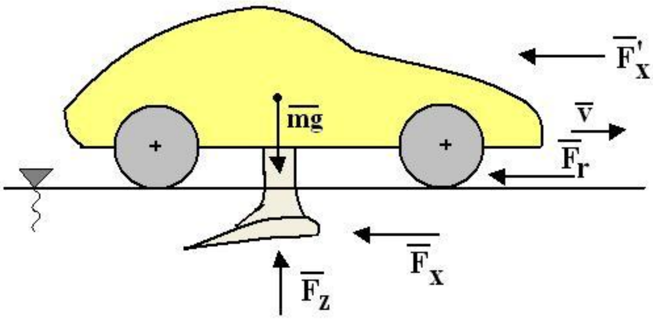

Fig.2. The forces which actuates over the hybrid vehicle

The aerodynamic resistance coefficient has two components:

$$C'_x = C'_{f_0} + C'_f \quad [-] \tag{4}$$

- C'_{f_0} is a shape coefficient free of speed, in function of vehicle’s geometry / architecture / shape;
- C'_f is a viscous, turbulent friction coefficient of the air with the vehicle’s body.

In the technical literature, [2] it can be found the following relation:

$$C_f = \frac{0.0742}{Re_L^{0.2}} \quad [-] \tag{5}$$

where the Reynolds friction criteria is:

$$Re_L = \frac{\rho \cdot v \cdot L}{\eta} = \frac{v \cdot l}{\nu} \quad [-], \tag{6}$$

L being the vehicle’s length, η the dynamic viscosity and υ the cinematic viscosity.

The lifting force, induced by the submersible wing is:

$$F_z = C_z \cdot S \cdot \frac{\rho \cdot v^2}{2} \quad [N] \tag{7}$$

and the hydrodynamic head resistance,

$$F_x = C_x \cdot S \cdot \frac{\rho \cdot v^2}{2} \quad [N] \tag{8}$$

Where S $[m^2]$ is the lifting area, ρ $[kg/m^3]$ is the water mass density and C_x, C_z are the hydrodynamic coefficients from the polar diagram $C_z(C_x)$ of the lifting profile.

The total head resistance of the vehicle is:

$$F' = F'_x + F_r = C_r \cdot m \cdot g + C'_x \cdot A' \cdot \frac{\rho_{air} \cdot v^2}{2} \ [N] \tag{9}$$

and the required power is:

$$N' = F' \cdot v \ [W] \tag{10}$$

$$N = C'_1 \cdot v + C'_2 \cdot v^{2,8} + C'_3 \cdot v^3 \ [W] \tag{11}$$

the complex, dimensional constants being:

$$C'_1 = C_r \cdot m \cdot g \ [N] \tag{12}$$

$$C'_2 = 0.0371 \cdot A' \cdot \left(\frac{\eta}{L}\right)^{0.2} \cdot \rho_{air}^{0.8} \left[\frac{N \cdot s^{1.8}}{m^{1.8}}\right] \tag{13}$$

$$C'_2 = \frac{C'_{f_0}}{2} \cdot A' \cdot \rho_{air} \left[\frac{N \cdot s^{1.8}}{m^{1.8}}\right] \tag{14}$$

The relations (11)... (14), shows the complex influence of the velocity to the consumed power for the head resistance diminution, making evident the importance of the three terms.

The total head resistance of the hybrid vehicle movement in water is:

$$F = F'_x + F_x = \left(C'_x \cdot A' \cdot \frac{\rho_{air}}{2} + C_x \cdot S \cdot \frac{\rho_{water}}{2}\right) \cdot v^2 \ [N] \tag{15}$$

and the required power is:

$$N = F \cdot v \ [W] \tag{16}$$

$$N = C'_2 \cdot v^{2,8} + (C_3 + C'_3) v^3 \ [W] \tag{17}$$

the dimensional constant being:

$$C_3 = \frac{C_x}{2} \cdot S \cdot \rho_{water} \left[\frac{N \cdot s^{1.8}}{m^{1.8}}\right] \tag{18}$$

On water, in repose (v=0), the volume of the immerse part necessary for floating is:

$$V = \frac{m \cdot g}{g \cdot \rho_{water}} \ [m^3] \tag{19}$$

In motion, over the water, when F_z=mg, the minim limit velocity is:

$$v_0 = \sqrt{\frac{2 \cdot m \cdot g}{C_z \cdot \rho_{water} \cdot S}} \left[\frac{m}{s}\right] \tag{20}$$

From the equality $F_{horiz} = F_i = m \cdot a = \frac{m \cdot g}{g} \cdot a$ (the inertia force) is obtaining:

$$\frac{a}{g} = \frac{F}{m \cdot g} \ [-] \tag{21}$$

where a [m/s^2] is the vehicle's acceleration.

There are using a hydro-mechanic analogy. The kinetic term from the theorem of conservation of energy (Bernoulli), specific kinetic energy can be written for variable motion:

$$\frac{v^2}{2\cdot g}=\frac{l}{g}\cdot\frac{dv}{dt}\left[\frac{N\cdot m}{N}\right] \qquad (22)$$

There are using the notations: l and t_0 – the crossing road and time; t is a current measure $t \in [0, t_0]$. Through the integration of the relation (22) will obtain the transient process time (the vehicle became ship).

$$t_0=\ln 49\cdot\frac{l}{v_0}=3{,}89\cdot\frac{l}{v_0}\ [s] \qquad (23)$$

and the speed increasing function in ratio with time:

$$\frac{v}{v_0}=\frac{e^{\frac{v_0}{l}\cdot t}-1}{e^{\frac{v_0}{l}\cdot t}+1}=\frac{e^{3{,}89\cdot\frac{t}{t_0}}-1}{e^{3{,}89\cdot\frac{t}{t_0}}+1}\ [-] \qquad (24)$$

This function (24) is asymptotic and it is considered that the transient process of transit at stationary regime stopped when $v = 0.96\cdot v_0$.

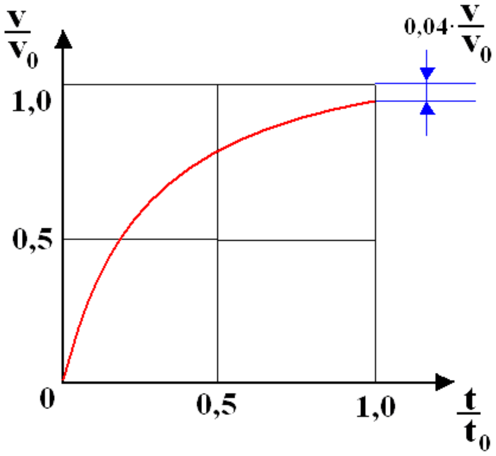

Fig. 3. Transition function in variable motion

At the limit the relation (22) permits the determination of crossing road.

$$l=\frac{v_0^2}{2\cdot a}\ [m], \qquad (25)$$

v_0 is determined with relation (20), and a/g with relation (21) it is obtaining:

$$l=\frac{m}{C_z\cdot\rho_{water}\cdot S\cdot\frac{a}{g}}\ [m] \qquad (26)$$

3 NUMERICAL APPLICATION

It is considered a vehicle-ship hybrid (fig.2) having the weight $m \cdot g$=12.5kN, the length L=4.5m, the maximum cross-section A=1.2m^2, the rolling resistance coefficient C_r=40N and the shape coefficient C_{f0}=0.3.

The atmospheric air has: p_{at}=100kPa, T_{at}=285K, ρ=1.22kg/m^3, the dynamic viscosity coefficient is $\eta=1.75 \cdot 10^{-5}$ Ns/m^2.

It is considered a hydro-dynamic wing, submersible, having C_x=0.2, C_Z=1.2. The water mass density is ρ_{water}=1025kg/m^3.

There were computed: F_r=500N, V=1.22m^3.

For velocity v_0=36km/h=10m/s, results the cinematic measures: a/g=0.17, a=1.67m/s^2, l=30m, t_0=11.67s.

The results of this calculus are showed in table 1 and in figure 4.

Table 1

Functional regime						
Vehicle				Ship		
v [m/s]	F'$_x$ [N]	F' [N]	N' [kW]	F_x [kN]	F [kN]	N [kW]
5	6.4	506.4	2.5	-	-	-
10	25.7	525.7	5.3	2.1	2.126	21.26
20	102.8	602.8	12	8.4	8.5	170
30	231.3	731.3	21.9	18.9	19.13	574
40	411.2	911.2	36.5	-	-	-
50	640	1140	57	-	-	-
60	925.2	1425.2	85.5	-	-	-

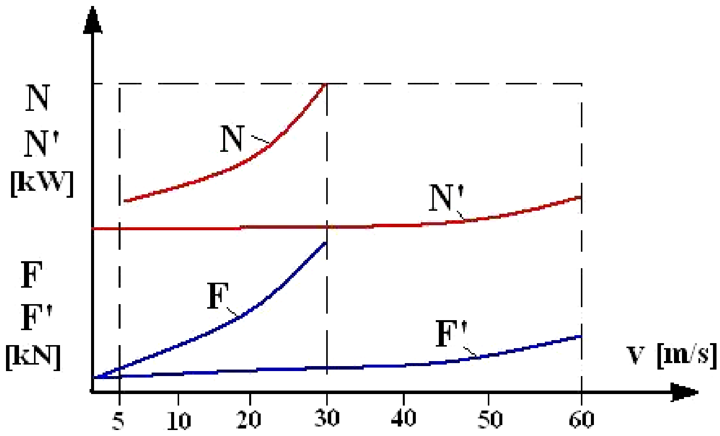

Fig. 4. The head resistance force and the required power

4 OBSERVATIONS

- The hydro-lifting force, equal with the vehicle total weight, can be ensuring easy at speeds starting from 10m/s.
- Through the increase of the value of hydro-lifting surface S it can be ensured the lifting F_z=mg, necessary at low speeds; at the speed increasing, S grows direct proportional with F_x and N.
- F_x and N has reasonable values at low speeds (at v=10m/s, N=21.26kW=29HP; at v=20m/s, N=170kW), bat are increasing with speed (at v=30m/s, N=574kW).
- This hybrid vehicle is recommended from an energetic point of view: for road of high speed and for water at speeds above 20 m/s.

5 CONCLUSIONS

The study allows the determination of the stationary movement components (with some velocity v) and variable transitory motion (cinematic measures: v, a, l, t and dynamic: F, N) of the hybrid vehicle for the ground and water movement.

The obtained relations allow the numerical compute of some concrete applications. The calculus precision depends on exact knowledge /estimation/assimilation of some performance coefficients (C_x,C_z, C'_x, C'_{f_0}, C_r), of some measures (A', S – constructive, ρ, υ, η – depending of fluids state), which assess complete information and experimental research.

The study, together with the numerical application helps in the field of design, dimensioning, optimization, reassessment, etc., of the hybrid vehicle's dynamics and energetic in variable motion.

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CONTRIBUTIONS AT THE ANALYTIC DEFINITION OF THE DYNAMICS OBSERVATION FOR SHIPS WITH SUBMERSIBLE HYDRO-LIFTING WING THROUGH THE ANGLE OF INCIDENCE/ATTACK

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Abstract: *In this paper it is presented an analytic study at the dynamics for a ship with submersible hydro-lifting wing, observed through the wing angle of incidence / attack, i = var. There are showed analytical relations $C_z(C_x)$ and the law i(v) optimal for the experimental model of wing with servo-controlled incidence, so that in the over-critic zone (when a steady geometry of the wing will induce the unbalance $F_z > m \cdot g$, F_z being the lifting force, quadratic increasable with the velocity v, and $m \cdot g$ the weight of the ship) it can be ensure: the lifting force $F_z = m \cdot g$ = const.; the moving hydrodynamic resistance F_z = const., invariable with velocity; the movement acceleration a = const; the consumed power, linear variable with velocity $N_x = v \cdot F_x$.*

Keywords: *submersible, hidro-lifting wing.*

1 THEORETICAL CONSIDERATIONS

The bend between the total weight $m \cdot g$ [N], the uplift force $\rho g V_c$ [N] and lifting force F_z, at speed v [m/s] in water of mass density ρ [kg/m^3], V_c [m^3] being the keel volume, is related through the vertical equilibrium:

$$m \cdot g - \rho g V_c - F_z = 0 \ \text{[N]} \tag{1}$$

The lifting force,

$$F_z = C_z \cdot S \cdot \frac{\rho \cdot v^2}{2} \ \text{[N]} \tag{2}$$

and the head resistance force,

$$F_x = C_x \cdot S \cdot \frac{\rho \cdot v^2}{2} \ \text{[N]} \tag{3}$$

Where:
S [m^2] – the lifting area;
C_x, C_z – the hydrodynamic coefficients.
The hydrodynamic head resistance force of the keel is:

$$F_{x,c} = C_{x,c} \cdot A \cdot \frac{\rho \cdot v^2}{2} \text{ [N]} \tag{4}$$

where A [m^2] is the maximum cross-section area;

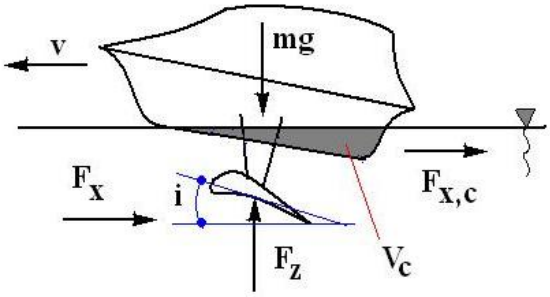

Fig 1. The forces which actuates over the ship

The total hydrodynamic head resistance force of the ship is:

$$F_{x,t} = F_x + F_{x,c} \text{ [N]} \tag{5}$$

and the required power is:

$$N_{x,t} = F_{x,t} \cdot v = \left(C_x \cdot S + C_{x,c} \cdot A\right) \cdot \frac{\rho \cdot v^3}{2} \text{ [W]} \tag{6}$$

The minimum power is obtaining at critical speed (velocity) v_*, when the lifting force equals the weight, F_z=mg, the ship is extracted from water, the keel volume is null V_c=0 and $C_{x,c} \cdot A$=0.

$$N_{x,t,min} = N_x^* = C_x \cdot S \cdot \frac{\rho \cdot v_*^3}{2} \text{ [W]} \tag{7}$$

The optimal critic velocity, from upper condition is:

$$v^* = \sqrt{\frac{2}{C_z} \cdot \frac{m \cdot g}{\rho \cdot S}} \text{ [m/s]} \tag{8}$$

And the minimum hydrodynamic power gets:

$$N_x^* = C_x \cdot S \cdot \frac{\rho \cdot v_*^3}{2} = \frac{(m \cdot g)^{1.5}}{\sqrt{C_x \cdot \frac{\rho}{2} \cdot S}} \text{ [W]} \tag{9}$$

In [1] is submit that $F_{x,c}=2 \cdot F_x$. It results:

$$\frac{N_{x,t,min}}{N_{x,t}} = \frac{N_x^*}{N_{x,t}} = \frac{1}{3} \tag{10}$$

That shows the economical advantage of hydro-lifting usage, at cancelling of the keel hydrodynamic resistance $F_{x,c}=0$;

$$C_{x,c} \cdot A = 2 \cdot C_x \cdot S\,[m^2] \tag{11}$$

If the velocity v* has an unacceptable value, the proposed transport velocity being v≠v* it can be chosen another wing from this condition:

$$C_z \cdot S = \frac{2 \cdot m \cdot g}{\rho \cdot V_*^2}\ [m^2] \tag{12}$$

From the equality $F_{x,t} = m \cdot a = \frac{m \cdot g}{g} \cdot a$ (the inertia force) is obtaining:

$$\frac{a}{g} = \frac{F_{x,t}}{m \cdot g} = \left(C_x \cdot S + C_{x,c} \cdot A\right) \frac{\rho \cdot v^2}{2 \cdot m \cdot g} = \left(C_x + \frac{A}{S} \cdot C_{x,c}\right) \cdot \frac{\rho \cdot v^2 \cdot S}{2 \cdot m \cdot g}\ [-] \tag{13}$$

where a [m/s^2] is the vehicle's acceleration.

2 NUMERICAL APPLICATION 1

It is considered a ship having the weight $m \cdot g$=830kN, the lifting wing of fixed position and geometry have S=6m^2, the angle of incidence i=12^o, C_x=0.2, C_Z=1.2. The water mass density is ρ_{water}=1025kg/m^3.

There were computed v_{opt}=v*=54km/h=15m/s, $F_{x,min}$=138kN, $N_{x,min}$=2070kW=2.7MW, a/g=0.167, a_{opt}=1.64m/s^2.

A decrease of the speed to v_0=36km/h=10m/s< v*, conduct to F_z=370N< $m \cdot g$, at the keel showing V_c=45.7m^3, at $F_{x,c}$=123kN, $F_{x,t}$=185kN, $N_{x,t}$=1850kW=1.85MW, a/g=0.222, a=2.18 m/s^2.

A increase of the velocity v=72km/h=20m/s> v*, using the same lifting wing, conduct at F_x=246kN, $F_{x,c}$=0, N_x=4.92MW, a/g=0.296, a=2.9 m/s^2.

For v>v*, results F_z>mg and goes to a unbalanced force (F_z-mg) which draws the ship from water and appears a vertical movement of exit and input in water.

The movement with v>v* must be realized by keeping the hydro-lifting F_z=mg=ct. That is possible with the appropriate decreasing of C_z coefficient.

For the over-critic area (v≥v*), the authors have studied the possibility of using a wing model with a variable angle of incidence i=var., articulated around a horizontal axle, passing through the entering edge. The characteristics obtained experimentally, in the interval i=5...12^o, are shown in table 1.

Table 1

i [^{o}]	12	8	5
C_z	1.2	0.932	0.675
C_x	0.2	0,156	0.1125

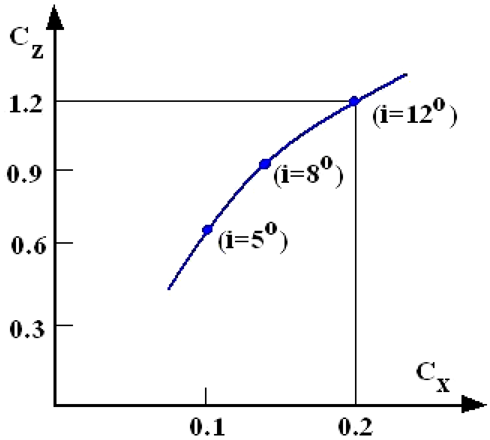

Fig. 2. The polar diagram $C_z(C_x)$

From the dates the authors have built the polar diagram $C_z(C_x)$, shown in figure 2, and the graphic representations of the hydrodynamic coefficients C_x, C_z in ratio with the angle of incidence i, from figure 3.

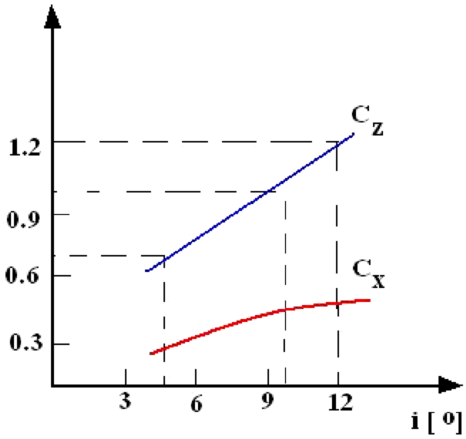

Fig. 3. The hydrodynamic coefficients C_x, C_z in ratio with the angle of incidence

The authors proposed linear approximations for the hydrodynamic coefficients function of the angle of incidence i=5...12^o:

$$C_z = 0.3 + 0.075 \cdot i \tag{14}$$

$$C_x = 0.05 + 0.0125 \cdot i \tag{15}$$

The law of lifting observation in over-critic area ($v \geq v^*$, $F_z = mg = ct$, $V_c = 0$, $F_{x,t} = ct$, a=ct, $N_{x,t}$ linear increasable with v) is:

$$i = \frac{3600}{v^2} - 4 \tag{16}$$

It seems evident the dependence of v and of incidence i of the hydrodynamic measures:

$$F_x = \frac{\rho \cdot S}{2}(0.05 + 0.0125 \cdot i) v^2 \ [N] \qquad (17)$$

$$N_x = F_x \cdot v = \frac{\rho \cdot S}{2}(0.05 + 0.0125 \cdot i) v^3 \ [W] \qquad (18)$$

$$F_z = \frac{\rho \cdot S}{2}(0.3 + 0.075 \cdot i) v^2 \ [N] \qquad (19)$$

In the over-critic area through i=var., $i \in [5,12^o]$, the correct correlation, servo-drive, i(v) can go at the measure constant F_x=ct, F_z=mg=ct, a=ct, invariable with velocity $v \geq v^*$, depending of ρ, S and m·g, and to the linear variation with velocity v of the power N_x.

It is introducing i from relation (16) in relation (17). It is obtained:

$$F_x = \frac{\rho \cdot S}{2}\left(0.05 + 0.0125 \cdot \left(\frac{3600}{v^2} - 4\right)\right) \cdot v^2 = 22.5 \cdot \rho \cdot S \ [N] \qquad (17')$$

It is introducing i from relation (16) in relation (19). It is obtained:

$$F_z = \frac{\rho \cdot S}{2}\left(0.3 + 0.075 \cdot \left(\frac{3600}{v^2} - 4\right)\right) \cdot v^2 = 135 \cdot \rho \cdot S \ [N] \qquad (19')$$

From (18) and (17') is obtained:

$$N_x = F_x \cdot v = 22.5 \cdot \rho \cdot S \cdot v \ [W] \qquad (18')$$

3 NUMERICAL APPLICATION 2

It is considered the same ship, having the hydro-lifting wing with i adjustable. The some calculus results are shown in table 2 and figure 4.

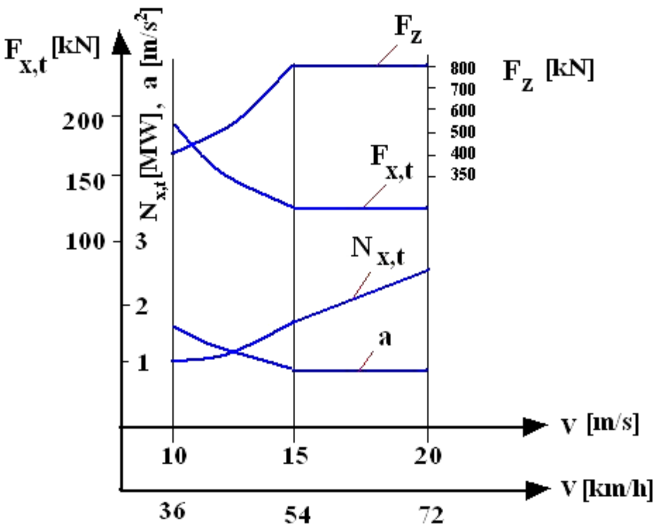

Fig. 4. Diagram for the same ship, having the hydro-lifting wing with i adjustable

Table 2

v	[m/s]	10	15	17	20
	[km/h]	36	54	61	72
i	Law	-	$i = \frac{3600}{v^2} - 4$		
	Value	12	12	8	5
C_z	Law	-	$C_z = 0.3 + 0.075 \cdot i$		
	Value	1.2	1.2	0.932	0.675
C_x	Law	-	$C_x = 0.05 + 0.0125 \cdot i$		
	Value	0.2	0.2	0.156	0.1125
V_c	[m^3]	47.5	0	0	0
F_z	[kN]	370	830	830	830
$F_{x,t}$	[kN]	185	138	138	138
$N_{x,t}$	[MW]	1.85	2.07	2.35	2.77
a/g	[-]	0.222	0.167	0.167	0.167
a	[m/s^2]	2.18	1.64	1.64	1.64

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EXPERIMENTAL RESEARCH REGARDING THE PHYSICO-CHEMICAL FEATURES OF THE METALLIC MATERIALS USED FOR THE MAKING OF THE BUSHINGS WITHIN THE MILITARY TECHNIQUE

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Abstract: *The materials used within the production of the bushings must have a series of physico-chemical features. These features influence the behaviour of the bushing during its functioning process. The present paper illustrates the results of the research made by the authors upon the physico-chemical features of two types of materials used in the making of the bushings within the military technique*.

Keywords: *material, bushing, chemical, physical, method.*

1 INTRODUCTION

The physico-chemical analysis made for the metallic materials used in the making of the bushings are:

- the determination of the chemical composition: Sn, Pb;
- the determination of the oxides, the quality of the protective atmosphere in the installation that makes the powder;
- the granulometrical analysis for the powders that are used in the making of the antifriction composites based on Cu-Pb;
- the determination of the time requires by the flow and of the apparent density of the powders used in the making of several types of bushings;
- the analysis of the microstructure of the metallic materials that appear in the composition of the making of the bushings in several stages of the making process: Cu-Pb, Al-Sn;
- spectrometric analysis of the composition of the antifriction materials based on Al-Sn;
- the determination of the Sn in the Al-Sn alloy;
- the determination of the Cu in the Al-Sn alloy;
- the determination of the Ni antifriction alloy Al-Sn;
- the analyses have respected the legal standard norms.

2 CHEMICAL METHODS REGARDING THE ANALYSIS OF THE METALLIC POWDERS USED IN THE MAKING OF THE BUSHINGS USED IN THE MILITARY TECHNIQUE

2.1 Determining the Tin

The tin is determined volumetrically by the titration with iodine of the 0.1 N solution – after a previous chemical fixation of the other Cu-Pb elements as follows: 1g of powder is being weighed, with a 0.0002g precision at the analytical scales; we pour it in an Erlenmeyer glass with the volume of 500 cm^3 over which we add 20 cm^3 of HCl 3:5 parts in order to obtain a violent reaction; after approximately 10 min, the sample is being boiled at a low fired adding 80 cm^3 HCl 3:5 volumetrically parts of 10 cm^3 of a mercuric chlorine, sol. 30 g/l, 10 cm^3 of an hypochlorous acid with a concentration of 30%; the boiling continues for approximately 5 min until the sample becomes clear; we cool it in a water bath under a dioxide carbon current; after it is cooled we add 10 cm^3 of a sodium sulphocyanide, potassium or ammonium, solution of 50 cm^3 potassium iodide, solution of 5 cm^3 of starch 1%, and we titrate it with a solution of 0.1 N.

The quantity of tin (g) is being determined with the help of formula nr. 1:

$$g\% = \frac{(V \cdot f \cdot 0.00593 \cdot 100)}{a} \tag{1}$$

where: V=the volume of the iodine solution, consumed within the titration (cm^3);

f=the factor of the iodine solution 0.1 N;

0,00593=the quantity of Sn^{4+}, (g), that corresponds to 1 cm^3 of iodine solution 0,1 N;

a=the mass of the sample.

2.2 Determining the Lead (The Electrolytic Method)

The lead is being determined electrolytically by using a platinum electrode (the sieve) as an anode. The weighed sample is being dissolved in a solution of azotic acid 25 cm^3 1:1, and a violent reaction takes place with precipitate deposits. The clear solution obtained by filtration is submitted to electrolysis in certain conditions. After the lead dioxide is being deposited on the anode, it has to be weighed and we calculate the lead quantity that exists in the sample. The depositing mechanism can be explained in the following way: on the anode we witness an oxidation of the Pb^{2+} and Pb^{4+} ions. This is how we obtain the tetra leaded nitrogenous and as a consequence of the hydrolysis, the lead dioxide is being formed, according to the reaction nr 2:

$Pb^{2+} + H_2O \rightarrow 4H^+ + PbO_2$, insoluble that is disposed on the anode (2)

The determination of the lead is being made in the following way: we weigh on an analytical scales (with a precision of 0,0002 g) the quantity of 0,25 g of powder in a Berzelius glass over which we add 25 cm^3 of HNO_3 1:1 (the acid is added carefully, the reaction being violent) we cover it with a watch gals and it is slowly warmed until the liquid's volume is being reduced up to its half, with the formation of a white roughgrained precipitate; we dilute it with hot water up to a volume of 125 cm^3 and then we boil it; we live it in a warm environment for an hour, and then we filter it still hot through a double filter with a blue stripe, we wash it with hot water until the blue marks disappear from the filter paper, the clear solution obtained after the filtration is submitted to an electrolysis; beforehand the electrodes have been weighed on the analytical scales (with a precision of 0,2 mg) and after them being introduced in the electrolit (the sample) we can make the necessary connexions and the agitator is being turned on, the depositing duration being of 45 minutes at the tension of 2,5-3,5 V with the intensity of 2,8 amperes; in order to see the end of the pepositing process we will complete the electrolit with distilled water and the depositing will continue for another 10 min; if nothing else gets deposited, the lead oxide that is already deposited on the electrilite is being washed without turning off the electrical current, replacing the electrolysis glass with another one that contains distilled water; the washing is being repeated 2 or 3 times, after which the current and the agitator are being turned off; the anode is being let loose from its holder and is quickly introduced in a gals full of alcohol after which it is being dried in a drying stove at 100°C for 5min; we cool it then in the dryer and then it is being weighed on the analytical scales. Knowing the initial weight of the anode (g_1) and the final one (g_2) as well as the weight of the analyzed powder (powder that here has 0,25 g) and the percentage content of lead we can obtain results with the help of formula (3):

$$G\% = \frac{\left[(g_2 - g_1)\,0.8662 \cdot 100\right]}{0.25} = (g_2 - g_1)\,346.5 \qquad (3)$$

where: 0.8662 = the transformation factor of the leaded dioxide in lead

In the end, the leaded bioxide gets away from the platinum through the process of decomposition into hydrochloric acid (with a dilution concentration of 1:1) and the copper deposited on the cathode will be dissolved with nitrogenous acid (dilution 1:1). The electrodes are being washed with distilled water, then dried in the drying stove and kept in the dryer.

3 PHYSICAL METHODS REGARDING THE ANALYSIS OF METALLIC POWDERS USED IN THE MAKING OF THE BUSHINGS USED IN THE MILITARY TECHNIQUE

3.1 Determining the Fluidity of the Powder

In order to determine the fluidity of the powder, we use a flowing funnel that has a calibrated orifice, a device that holds the funnel (without any vibration) and a timer [1, 2].

The fluidity of the powder is determined as follows: 50 g of samples are being weighed on the technical scales (precision of 0,1 g), the sample is being poured into the funnel so that it is completely filled; we measure the time during which the powder flows – time that represents the fluidity and it is expressed in seconds.

3.2 Determining the Apparent Density

The apparent density is being determined as following: we weigh with the technical scales (with a precision of 0,1 g) a quantity of 80 g of powder in a bucket shaped pot that has a volume of 14 cm^3; the powder is levelled at the surface with the help of a spatula, avoiding the trepidation of the pot, that might influence the volume; after the levelling the extra powder is being removed in order to avoid the weighing losses; we weigh it again full of the subsided powder.

The calculus of the apparent density (g/cm^3), is made with the help of formula (4):

$$\rho = \frac{a}{v} \tag{4}$$

where: a = the quantity of powder (gram) weighed after the flowing

v = the volume of the bucket shaped pot where we collected the sample

3.3 The Craniometrical Analysis

This method determines the proportions of different sizes of granules from the granulled mixture Cu-Pb with a set of standard sieves with a mechanical stirring [3, 4].

In table no. 1 we have presented the equivalences between the number of the sieve and the powders used in the making of the bushings.

Table no. 1.The COMPULSORY characteristics of the powders

No. of the sieve	*Tyler-Nesb equivalent*	*The size of the sieves expressed in microns*
80	80	177
100	100	149
110	150	105
200	200	74
270	-	-
325	325	44
tray	remainings	-

The granulometrical analysis is being made as follows: we weigh at the technical scales 100g of sample and we put it in the sieve no.80; we cover it with a tin made of steel, we make sure that the sieves do not move; we start the steering, we stop the sifting after 15 min.

On a cut paper we successively empty every sieve and we weigh all together all the powder in all the sieves, in the end the quantity representing precisely 100 g.

3.4 Determining the Oxides

The devices that we used are being made out of: the synthesizing installation, porcelain gondolas, dryer and analytical scales. The method that we used verifies the drying system of the powder as well as the quality of the protective atmosphere used in the installation that produces the powder. [2, 3].

The steps are the followings: we weigh at the analytical scales (with a precision of 0,2 mg) 20 g of powder in a porcelain gondola, on the bottom of which we added a thin layer of aluminium carbonate in order to prevent the impregnation of the lead in the gondol; the gondola with the ponder on the margins of a steel stripe in the synthesizing installation has a neutral atmosphere; after the technological synthesizing flux, the gondola with synthesized powder is being removed from the stripe and it is being kept in the dryer until it is fully culled off, after which it is being weighed.

The weigh loss of the sample in the atmosphere (G%), oxides, is being determined with the help of formula (5):

$$G\% = \frac{(g_1 - g_2)}{g_1} \cdot 100 \qquad (5)$$

where: g_1= the weigh of the sample quantity (grammes) before the sintering
g_2= the sample weigh (grammes) after the sintering

In table no.2 are presented the compulsory characteristics of the powders used in the making of the bushings.

Tab.2. The COMPULSORY characteristics of the powders used for different types of bushings

The quality of the powders	*The granulometrical analysis Taler %*	*Flowing time (seconds)*	*The apparent density (g/cm³)*	*The chemical analysis*		*Max no. of oxides*
				%Sn	%Pb	
CP10S10	max. 82	18-30	4.06-5.47	9.5-11.5	10.2-11.7	0.55
CP23S2	max. 77	17-30	4.17-5.73	1.2-2.2	21.2-26.7	0.55
CP22S4	max. 80	17-30	4.23-5.70	3.8-4.8	20.2-25.7	0.55
CP26S6	max. 70	max.30	4.8-5.5	1.2-2.2	24-30	0.55

The qualitative results obtained after the granulometrical analisys (by sifting) have been interpreted as to result the granulometrical distribution

4 CONCLUSIONS

Since the antifriction material based on sintered Cu-Pb powders has a metallic structure, the connections are being established during the process of sintering between the granules of the powder and they can be explained by the interatomical forces that appear in the crystalic network that metals have.

Theoretically speaking, between the granules of the powder we have a metallic contact; practically, it is very rarely made because of a layer of oxides that is to be found at the surface of the granules.

The concentration that these oxides have is controllable and it must not overcome the imposed value of 0.55%, when talking about the researched powder, in order not to change the already formed metallic structure.

When sintering throughout warm up, the atoms of the powder are being rearranged within the network so that the structure of the crystalic network can be formed.

Due to the heat, in the sintering oven, the powder put on the steel pot is subdued to the diffusion phenomenon (in a solid stage) at the surface and upon the volume as well. It is explainable through the fact that the atoms situated on the tops of the granules of the powders are moving on the surfaces, gathering themselves on the non-uniform parts of the surface. At higher temperatures we can witness diffusion at the level of the granules of the powder and the ones of the steel as well.

After the research made, we ended up to the conclusion that the apparent density is influenced by the way in which the powdered is being obtained, by the drying temperature as well as by the granulometrical class. The softer powder has a higher apparent density than the rough one.

It can also be seen that if the apparent density of the alloy is higher, the powder is much more compact, and the spaces within the granules are smaller.

The powder density is lower than the one of the alloy, thing that underlines a higher porosity of the sintered material.

The size of the granules and their granulometrical distribution are physical properties that have a tremendous importance that may influence the technological properties of the powders and of the sinterised finite products.

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EXPERIMENTAL RESEARCH REGARDING THE QUALITY OF THE PLATING OF THE ANTIFRICTION MATERIAL WHEN DEALING WITH BUSHINGS USED IN THE MILITARY TECHNIQUE

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Abstract: *The plating of the antifriction material used for the making of the bushings must have a series of very important properties for the bushing itself. The quality of the plating influences the quality of the bushing as a whole, but also its behaviour while working. The present paper highlights the results of the research made by the authors upon the quality of the plating of the antifriction material used in the making of the bushings used in the military technique.*

Keywords: *bushing, military, antifriction, material.*

1 INTRODUCTION

The bimetal with an antifriction material with an aluminium base is being made by the plaking of the antifriction material on the steel base, and the bimetal with a copper base is being made by the sintering of the antifriction material on a steel base.

The basic steel stripe must be rolled at warmth, calibrated at cool and re-backed in order not to have faults like: superficial slag inclusions, rolling overlappings, oxides residues after the scaling, foreign bodies, cracks.

The layer of material must show some physico-chemical properties: minimal thickness, when being pulled after the rolling, shearing resistance, adherence towards the steel base [1, 3]

2 EXPERIMENTAL RESEARCH REGARDING THE ADHERENCE OF THE ANTIFRICTION LAYER

The adherence of the antifriction layer of alloy on a steel base is a very important property for the bimetal materials used in the making of the bushings used in the military technique [2]. It can be determined throughout the method of chiselling and the method of peeling-off.

2.1 Determining the Adherence

The adherence is being determined by the rough peeling-off of the antifriction layer throughout chiselling. It is being done by a manual forced pulling-off of the antifriction layer, with the help of a tongs, until the breaking of the peeled-off alloy stripe. The chiselling is being made in the central area and on the margins at a length of 8-10 mm.

The length of the peeling-off of the antifriction alloy for an acceptable adherence is of maximum 50 mm.

The margins of the peeled-off antifriction alloy must have the tendency of uniting themselves (in order to form a pointed angle).

When peeling-off the margins of the torn antifriction material away from the steel basis when chiselling, the adherence will be considered inappropriate.

The extreme cases will be analyzed in order to make a decision. When realizing that an adherence is inappropriate, a new baking will be made (in the same conditions as the first time), on different areas of the twist or on the entire twist.

2.2 Verifying the Adherence

The verifying of the adherence of the layer of the antifriction material based on Cu is being made on a test-bar of 200 mm taken from the bimetal blade. The test-bar is being bent according to figure no. 1

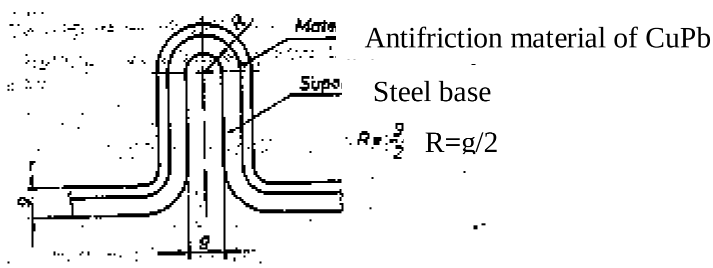

Fig. 1. The shape of the test-bar when trying to bend it

When verifying the adherence of the layer of antifriction material based on sintered Cu-Pb on the steel base is being done on a special device C-005-00 “the machine that trys the sintered sripes”. The adherence is being checked on a stripe sample made of bimetal, having a length of 200-250 mm and a width that is equal to the bimetal stripe. The samples will be put out of every twist, at the beginning and at the end of it, at a distance of approx. 1-1,5 m far from the ends.

The samples used in order to determine the adherence of the layer of the antifriction material are presented in figure no. 2.

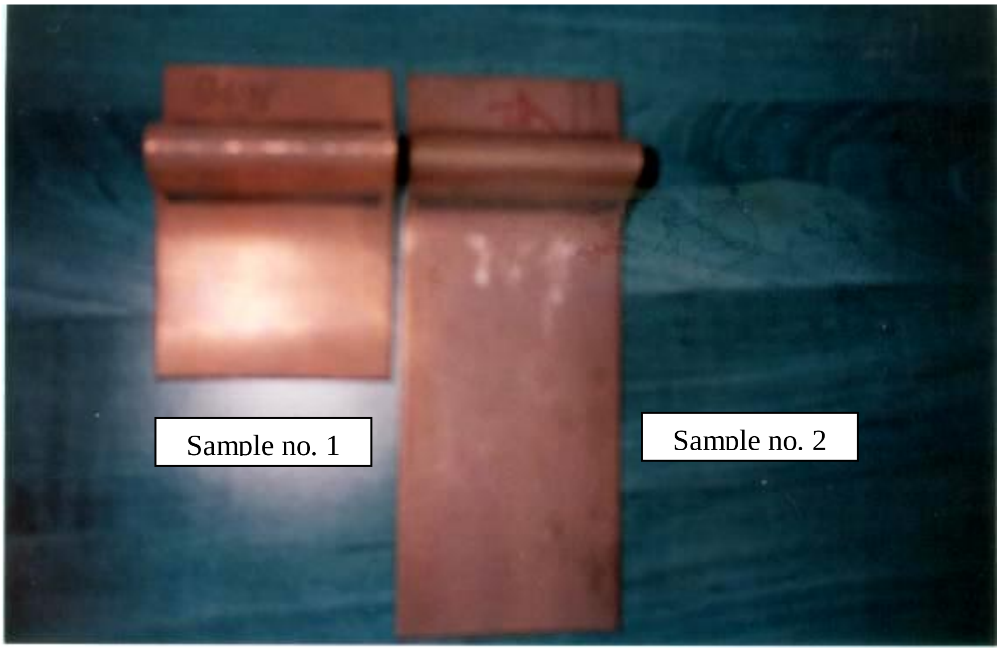

Fig.2. The samples used when trying to bend the sintered antifriction material based on Cu-Pb

The layer of antifriction material based on Cu, sintered, must have an adherence towards the steel base so that after the bending of the test-bar, in the bending area, min. 90% of the surface to remain covered by the antifriction material.

2.3 Interpreting the Aspect of the Bending, Respectively the Adherence of the Sintered Layer on a Steel Base

The analysis of the bending is being made under the microscope with an enlargement of 30X. Around the area of the bending, towards the alloy we can see different cracks or even exfoliations of the sintered alloy [4]. Accordingly to the cracking or exfoliation degree of the sintered layer, on the steel base studied around the bending, we can establish the following adherence categories:

a. good adherence – accepted stripe

This aspect is specific for all types of alloys based on sintered CuPb.

Around the bending, the antifriction alloy presents a series of superficial cracks (that do not reach the steel – sample no. 2), or only stretching of the alloy (specific for the lighter color – sample no. 1)

b. satisfying adherence - stripe accepted at the limit

This aspect is specific for the antifriction alloys based on CuPb sintered with Sn.

Around the area where the antifriction alloy was bent we can see a series of cracks towards its depth (down to the steel) for alloys with Sn<1% and even the exfoliation of the sintered layer on the steel base for the alloys with Sn>1%.

In this case, on the surface of the steel that remains untouched after the exfoliation we will try with a knife, throughout scratching, to see if there are any residues of sintered alloy.

If we cannot establish if on the steel base around the bending area there are any residues of sintered alloy, that particular area will be treated with a solution made up of oxygenated water, acetic acid and distilled water.

In this way, the lead will be dissolved in this solution, and the copper grains will be more distinguishable.

The surface covered with sinter alloy residues must represent approx. 90% of the entire bending surface.

c. unsatisfying adherence – rejected stripe

Around the bending area of the alloy with Sn 1% cracks and becomes totally loose from the steel surface. The alloys with Sn 1% are inappropriate for adherence, if on the steel surface there are no traces left from the sintered alloy detectable with the blade of a knife or after the chemical treatment. In this case several tests will be made, taking samples from the different areas of the twist. We would also try to increase the adherence by a new sintering with a lower velocity and a rolling with a reduction of 3%. If after all these operation the adherence is totally missing, the entire twist will be returned.

3 CONCLUSIONS

When dealing with bimetal stripes used in the making of the bushings used in the military technique, faults as following are not permitted: surface or marginal cracks, inclusions of foreign bodies, visible faults on the surface, or hidden ones, coming from the rolling operation.

The stripes that have cracks on the surface must be submitted to the operation of chiselling in order to determine if the crack did not favour the oil contamination of the checking surfaces.

The marginal stripes grown due to the wrong overlapping of the alloy will be cleaned by chiselling.

The steel base must not have inclusions or traces of slag. The admitted rugosity being R_a=1.6 μm.

The colouring of the steel base might be brownish or greyish, as a result of the new backing of the stripe.

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CAD-CAE INTERFACING BY RELATIONAL TECHNIQUES

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***Abstract**: This paper presents a way for interfacing CAD and CAE tools, meant to increase the precision and productivity for the geometric modelling process. It is presented the example of interfacing between the Multisurf and Cosmos/M applications, used for modelling and for the FEM analyze of the ships. A series of eager program code were used for achieving the data format transforming. The presented procedure has been used in some research projects for ships of various sizes and structure types.*

***Keywords:** CAD, CAE, application, ship.*

1 GENERALITIES

One of the major problems, constantly present, is that of, in spite of continuously progresses recorded by the CAE programs, the geometric modellers they contain are still of a reduced performance. Such modellers allow geometric modelling of middle complexity but are difficult to be used in case of big models of high complexity. In addition, they require from the operator a big handy work volume, with serious implications on the accuracy and productivity.

Amongst other deficiencies of the CAE geometric modellers there are:
- reduced possibilities for hierarchical management of geometric elements;
- inflexibility of generated models;
- difficult detection of errors in the generated models;
- difficulties in modifying the models.

The above enumerated difficulties are occurring in different degrees in the most of the existing CAE programs. They can be less troubles making in the case of small or middle applications, but truly discouraging for big and complex models.

For the above reasons the authors frequently preferred to avoid the use of CAE geometric modellers, each time this was possible. Instead, has been preferred the use of external resources, using CAD geometric modellers, powerful and highly specialized. In these conditions, it occurs the problem of format compatibility for the CAD geometric model files and the data types accepted by the CAE programs.

2 THEORETICAL BACKGROUNDS

The shortest and the easiest way of interfacing consist in exporting the data from the CAD program and its directly importing in the CAE program. Unfortunately, this method can be used in very few cases, the information passed by this way needing to be completed in the CAE modeller.

As the principle, a CAE program can be seen as being composed by two modellers: a geometric modeller and a physical modeller. According to this idea, the above mentioned technique works as the Figure 1 shows.

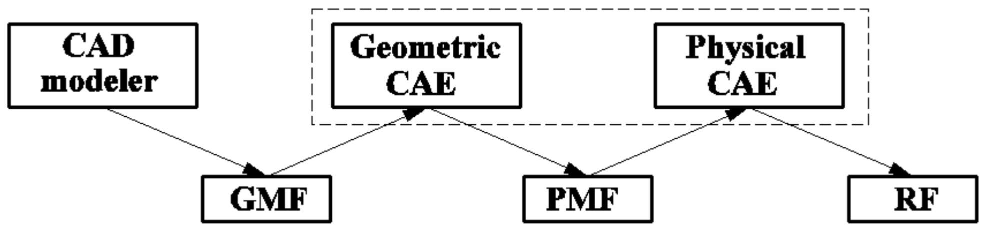

Figure 1

The abbreviations used in the Figure 1 are as follows:
- GMF – Geometric Model File, containing the geometric information supplied by the CAD modeller;
- PMF – Physical Model File, containing both the geometry and the physical information needed by the CAE program for solving the proposed task;
- RF – Results File.

The operations stream is unavoidable passing through the CAE geometric modeller, even just for introducing geometric data by handy or automatic importing techniques.

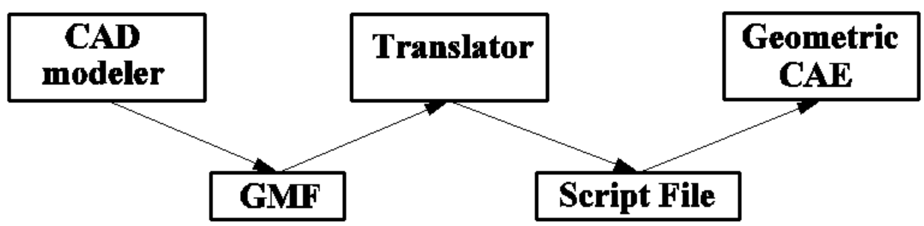

Figure 2

An effective interfacing technique consists in completely importing the geometric data. By this way the use of geometric modeller of CAE is reduced to minimum by eliminating the handy operations (completions or/and corrections).

For this purpose are useful those CAE programs accepting command languages (the so called script languages). In this case the working scheme becomes that in the Figure 2 presented.

The Translator component may consist in a program having the task of transforming the GMF from the format given by the CAD program to the format of commands accepted by the CAE program, generating the Script File.

3 PRACTICAL APPLICATIONS

The overall working scheme above presented was achieved using the following specific parts:

- As the CAD program it has been used Multisurf from Aero Hydro Inc. This is a geometric modeller dedicated for generating surfaces using the so called Relational Geometry, in which the model is constructed based on a system of relations between the component geometric parts. Compared to other CAD systems this one allows a very convenient management of the geometric model, especially when changing sizes and locations of geometric elements. When a good relational system rules over the model, any change of a certain part of the model involves the automatic change of the related parts.
- As the CAE program it has been used COSMOS/M for FEM analyse;
- As the Translator program it has been used EXCEL and some eigen VBA procedures.

The subject of the applications has been a series of ship structures.

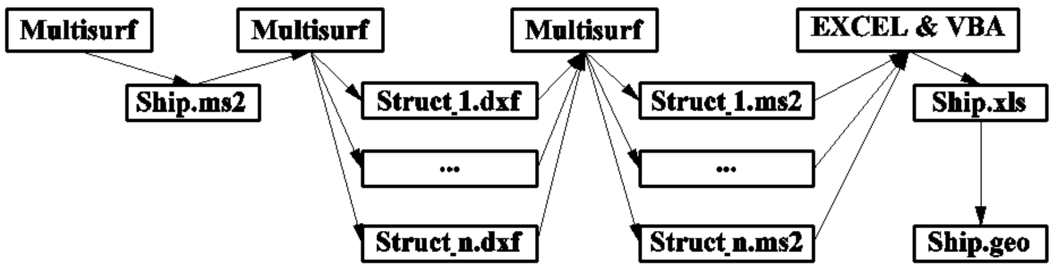

Figure 3

Using specifically capabilities of the mentioned programs, the working stream becomes that from Figure 3. The steps are as follows:

1) Modelling the whole ship structure for small or medium size ships. For the case of big ships the structure can be made dividing the whole ship in several parts, separately generated but related each other for the points of the coupling sections. The step is accomplished using Multisurf. As the result, it is the file Ship.ms2, composed by elementary NURBSurf entities defined by only 4 points, the surface degree being 1 both for u and for v directions, and the divisions number being 1x1 for the both directions;
2) Using also Multisurf, from the file Ship.ms2 are extracted group of surfaces representing parts of the ship structure having common characteristics as are the type (longitudinal, frames, etc.) and thickness. They are noted by Struct_1.dxf, …, Struct_n.dxf in the Figure 3;
3) The structural dxf parts are imported in Multisurf as corresponding ms2 files. By this procedure, the NURBSurf are transformed in BloftSurf entities composed by 4 points and 2 curves. Here, a series of chained VBA procedures do the transformation of BloftSurf entities in points and SF4PT entities for COSMOS/M program (surface by

4 points). All the transformed entities are written into an EXCEL file (Ship.xls) where the whole ship structure is redefined and its different parts are related each other as the indexes and definitions, the result being the export of the Ship.geo command file.

4 APPLICATION EXAMPLES
4.1 Rapid Ship Modelling

In the Figure 4 and 5 are presented the main parts of a rapid ship structure.

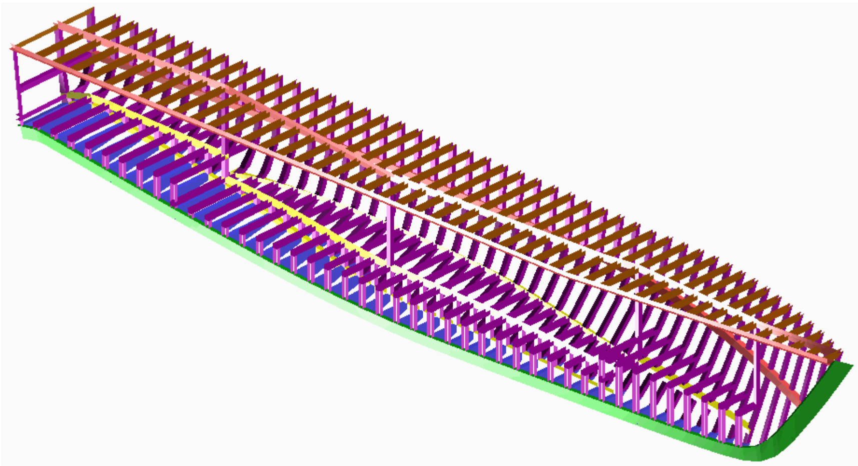

Figure 4

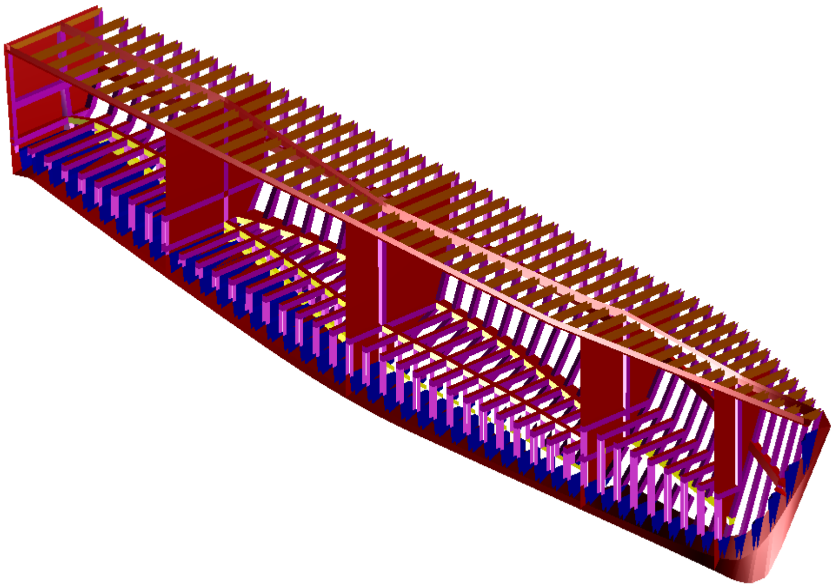

Figure 5

The ship is 25m long and the geometric entity numbers used for modelling this ship in the GEO file have been 9016 points and 5514 surfaces. Because the surfaces number has not exceeded 8000 (as it is the maximum allowed by COSMOS/M), it has been used a single file for the geometric model.

4.2 Multi Purpose River-Maritime Coastal Ship Modelling

In the Figure 6 are presented the main parts of a multi-purpose river-maritime coastal ship structure.

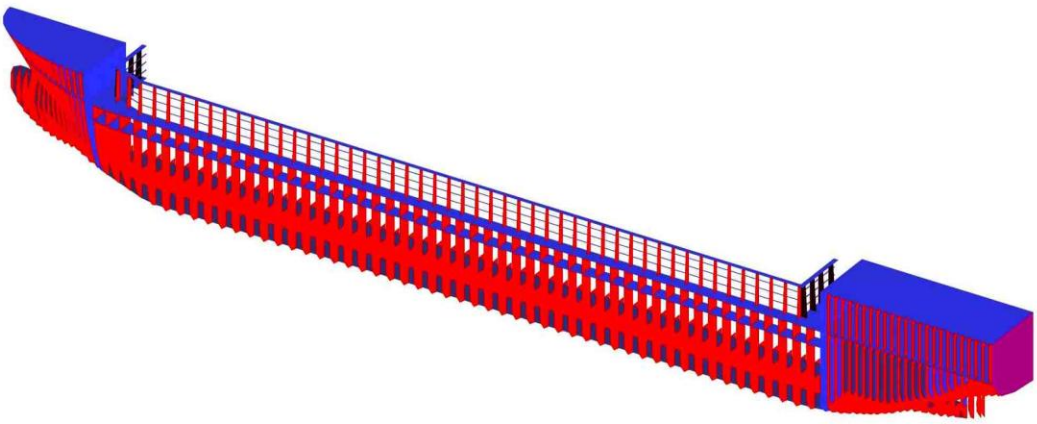

Figure 6

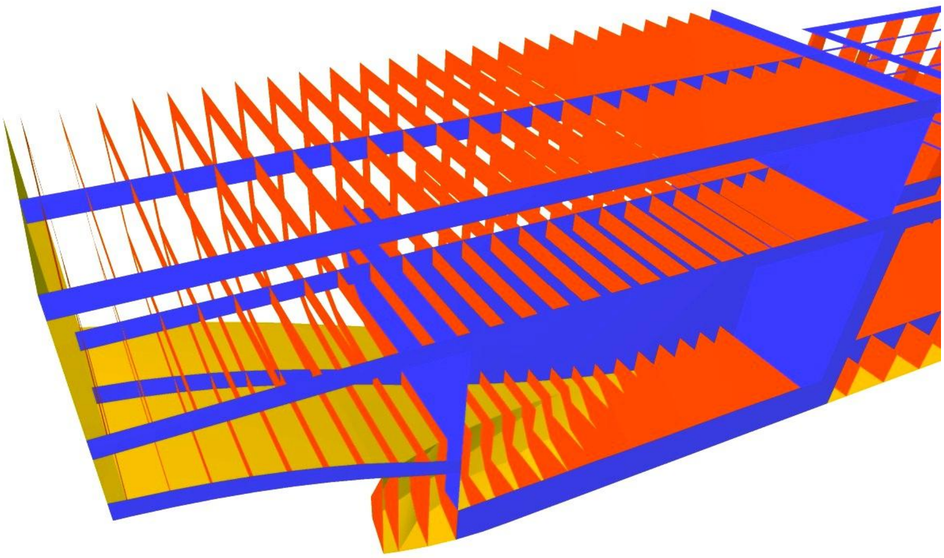

Figure 7

The ship is about 85m long and the geometric entity numbers used in the GEO file are 6524 points and 3850 surfaces and, also, needed a single GEO file. Given the long cylindrical part of the ship hull and the absence of longitudinal structural elements in this part, the geometric entity numbers used here have been smaller than those used for the model of rapid ship, because the shape allowed the use of big plane panels of surface.

In the Figure 7 it is presented the ship poop, where it can be noticed the high degree of ship body detailing.

4.3 Liquid Gas-Carrier Ship Modelling

In the Figure 8 are presented the main parts of a liquid gas-carrier ship structure.

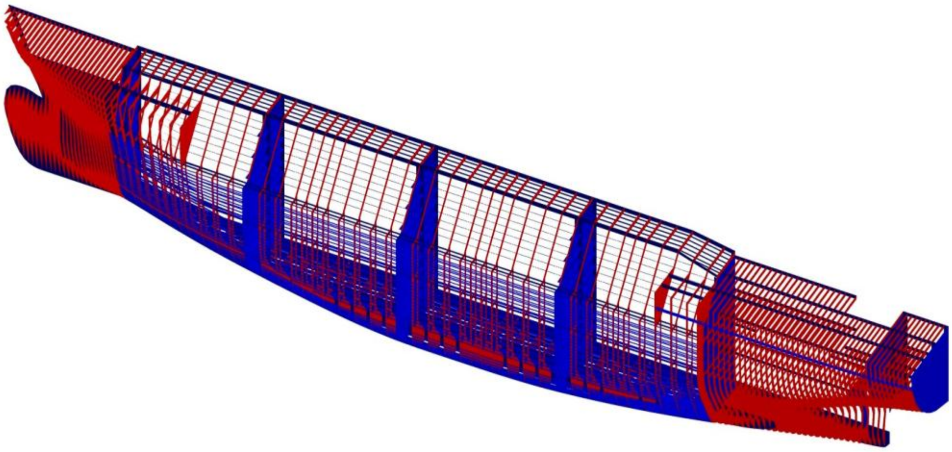

Figure 8

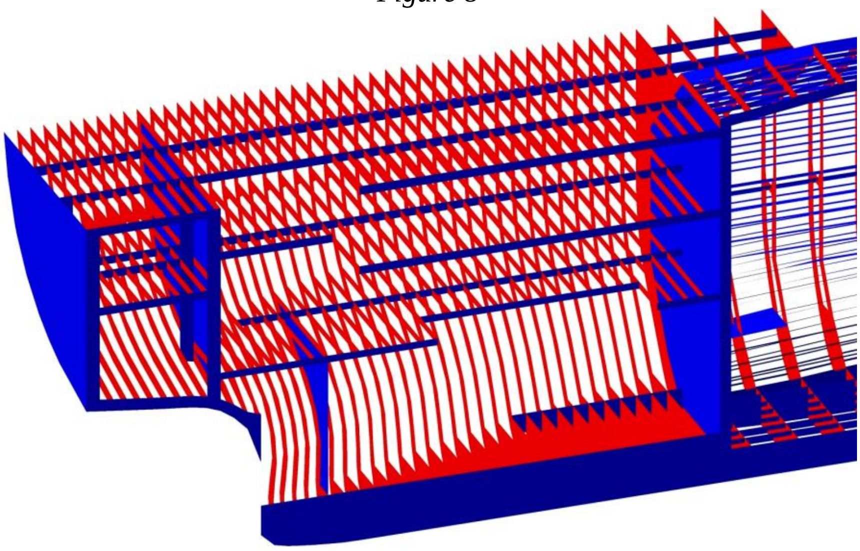

Figure 9

As it can be seen, the ship has no cylindrical part and the structure is enough complicated. Consequently, the surfaces number will be higher than 8000, so that this sheep has been divided in 4 segments. The total number of geometric elements has been 31823 points and 20376 surfaces.

As for the FEM elements used in the COSMOS/M program, this depends on the meshing settings.

In the Figure 9 and 10 are presented the fore and aft parts of the ship.

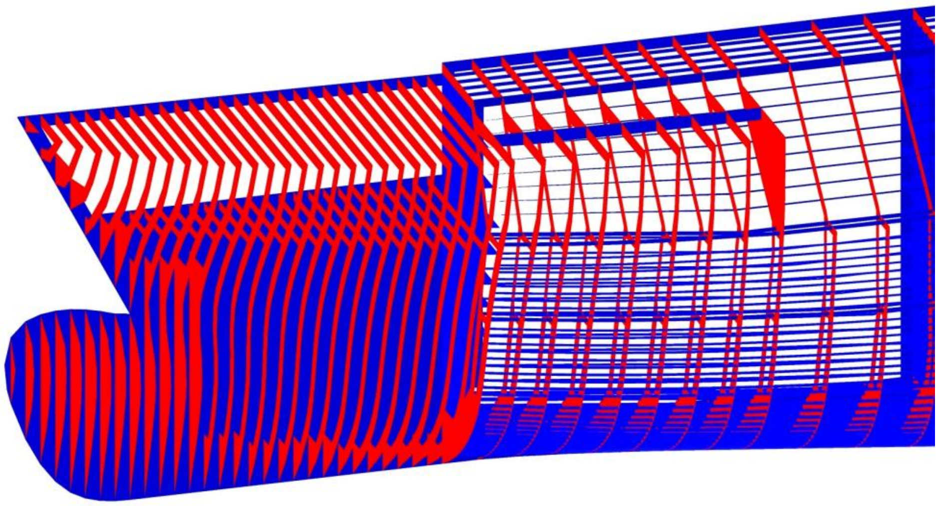

Figure 10

5 CONCLUSIONS

The presented method allows processing of big and complicated geometric models in reasonable time and effort conditions.

But the most important feature of the method is the possibility of relative easy change or correction of the model when necessary. This is possible because of the nature of Multisurf as Relational Geometry Modeller.

As the results of the applications demonstrate, the accuracy of the models is very high and the operations can be easily done.

ACKNOWLEDGMENTS

The work has been performed in the scope of the national project EU-RAPIDSIG, Series of rapid support ships, which has been financed by the Romanian Education and Research Ministry under contract MCT-CEEX-M1/ EU-RAPIDSIG-91/ PC-D07-PT26-610/ 2005-2007, and of the national project MARITIME GAS TRANSPORT M1-PT26-X2C16, as well as for other projects.

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THE NUMERICAL ANALYSIS OF STEADY STATE AND TRANSITORY DYNAMIC RESPONSE FOR A BARGE TEST SHIP, BASED ON THE HYDROELASTICITY THEORY

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Abstract: *This paper is focused on the validation of the DYN eigen program code, for the ship dynamic response analysis, based on the hydro elasticity theory, using experimental data for a barge type test ship. First, it is presented the frequency domain analysis for the vertical displacement response amplitude operator of the barge model. Secondly, it is presented the time domain analysis of the transitory vertical displacement response of the barge model, under initial imposed forepeak motion conditions. The Bureau Veritas Register, in the frame of EU-FP6 MARSTRUCT project, supplies the test ship and experimental data. The obtained eigen numerical results are in good agreement with the experimental data.*

Keywords: *ship, barge, hydroelasticity.*

1 INTRODUCTION

In the case of elastic ship girders, the dynamic ship response induced by sea waves has significant vibration components, so that the numerical analyses have to be carried on under the hypotheses of the hydro elasticity theory.

This study is focused on the validation of the eigen program code DYN [2], which has been developed in order to analyse the coupled oscillations and vibrations ship dynamic response. The validation is based on the experimental data for a barge test ship, proposed by the Bureau Veritas Register [5].

2 THEORETICAL BACKGROUNDS

2.1 The theoretical model for steady state linear modal dynamic ship response

The linear frequency domain analysis theoretical model for the ship steady state dynamic response is implemented into the HEL module of the DYN [2] program, under the following hypotheses:

1) The ship hull girder is modelled using beam finite elements (1D-FEM) [3].
2) The hydrodynamic forces are calculated according to the strip theory, Gerritsma & Beukelman [1] that are functions of the elastic ship response. Based on the modal analysis technique, it is considered the ship dynamic response decomposed on r=0,1 oscillations modes and r=2,n the first eigen vibration modes of the elastic ship girder.

3) The hydrodynamic masses and damping coefficients for the linear analysis are constant in time, calculated at the wave circular frequency ω, in still water condition, based on Vogt's method [1].
4) At the linear analysis, it is considered an external excitation linear head wave, Airy model [1],[2],[3], and the ship speed is zero.

The ship steady state linear dynamic response in vertical displacement, according to the modal analyse technique, is decomposed as following:

$$w_{lin}(x,t) = \sum_{r=0}^{n} w_r(x)\, p_{lin\_r}(t); \quad x \in [0,L]; \quad n = 4 \tag{1}$$

where: $w_r(x)$ are the modal form functions resulting from 1D-FEM free vibrations analysis; $p_{lin\_r}(t)$ are the linear principal modal coordinates; L is the ship length.

Based on the above hypotheses, the ship linear motion equations system in vertical plane, in principal modal coordinates formulation and matrix form is:

$$[A(\omega)]\{\ddot{p}_{lin}(t)\} + [B(\omega)]\{\dot{p}_{lin}(t)\} + [C(\omega)]\{p_{lin}(t)\} = \{F_w(t)\}_{Airy} = (\{F_1\} + i\{F_2\})\, a_w e^{-i\omega t} \tag{2}$$

where: a_w, ω are the amplitude and the circular frequency of the Airy [3] linear head wave; $[A(\omega)], [B(\omega)], [C(\omega)]$ are the generalized inertial, damping and strength matrix, including the structural and hydrodynamic terms; $\{F_w(t)\}$ is the generalized wave excitation force based on a complex Airy [3] wave model formulation.

From equation (2) it results an equivalent linear algebraic system:

$$\{p_{lin}(t)\} = (\{P_1\} + i\{P_2\})\, e^{-i\omega t} \Rightarrow [D(\omega)]\{P\} = \{F\}; \; \{P\} = \{\{P_1\},\{P_2\}\}; \; \{F\} = \{\{F_1\},\{F_2\}\}$$

$$[D(\omega)] = \begin{bmatrix} [C(\omega)] - \omega^2 [A(\omega)] & \omega [B(\omega)] \\ -\omega [B(\omega)] & [C(\omega)] - \omega^2 [A(\omega)] \end{bmatrix} \tag{3}$$

which can be solved using a standard Gauss library procedure [3].

The solution of system (3), for a_w=1 , ω=0÷10 rad/s, it is used for the calculation of ship displacement linear dynamic response amplitude operator RAO_w.

$$w(x,t) = \mathrm{Re}\left\{\sum_{r=0}^{n} w_r(x)(p_{1r} + i p_{2r})\, e^{-i\omega t}\right\} = w^1(x,\omega)\cos\omega t + w^2(x,\omega)\sin\omega t \tag{4}$$

$$RAO_w(x,\omega) = \sqrt{[w^1(x,\omega)/a_w]^2 + [w^2(x,\omega)/a_w]^2}$$

2.2 The theoretical model for non-linear transitory dynamic ship response

The non-linear time domain analysis theoretical model for the ship transitory dynamic response is implemented into the TRANZY module of the DYN [2] program. The hypotheses 1-3 from the linear analysis are preserved and the last 4,5 are replaced with specific hypothesis of the non-linear analysis, as following:

6) The hydrodynamic terms on the eigen rigid modes r=0,1 are calculated at the ship vertical oscillation circular frequency ω_{osc}. The hydrodynamic terms on the eigen vibration modes r=2,n are calculated for ω_2 , the circular frequency of the fundamental vibration mode.

7) The hydrodynamic forces include of the non-linearity's due to the time variation of the hydrodynamic coefficients, at the instantaneous ship-wave position, and also the impact-slamming component.
8) There is no external excitation wave taken into account, so that no stabilized response occurs.
9) The speed of the ship is zero and the ship-girder initial conditions are non-zero displacements.

The ship transitory non-linear dynamic response in vertical displacement, according to the modal analysis technique is decomposed as following:

$$w_{nl}(x,t) = \sum_{r=0}^{n} w_r(x)\, p_{nl\_r}(t); \quad x \in [0,L]; \; n = 4 \tag{5}$$

where: $p_{nl\_r}(t)$ are the non-linear principal modal coordinates.

Based on the hypothesis 1-3 & 6-8, the ship non-linear motion equations system in vertical plane, in principal modal coordinate's formulation is:

$$[A]\Big|_{\omega 2}^{\omega osc}\{\ddot{p}_{nl}(t)\} + [B]\Big|_{\omega 2}^{\omega osc}\{\dot{p}_{nl}(t)\} + [C]\Big|_{\omega 2}^{\omega osc}\{p_{nl}(t)\} = \{F_{nl}(t, \{p_{nl}\}, \{\dot{p}_{nl}\}, \{\ddot{p}_{nl}\})\} \tag{6}$$

where: $[A]$, $[B]$, $[C]$ are the generalized inertial, damping and strength matrix; $\{F_{nl}(t)\}$ is the generalized non-linear excitation force, including the non-linear hydrodynamic and hydrostatic terms, respectively the impact-slamming term.

Because $\{F_{nl}(t)\}$ is function of the transitory dynamic response $\{p_{nl}(t)\}$, it is necessary to use an integration in time domain method (7), based on the β-Newmark (β=1/2) algorithm [3], in order to solve the motion equations system (6). The simulation time is T_s=8s with a time step $\delta t = 0.001s$ and the triggering frequency f_{es}=1000Hz. There are obtained 8001 values into a time record file at each transversal section. Applying the spectral analysis with the Fast Fourier Transformation (FFT) [3] to the calculated time records, there can be obtained the amplitude spectral functions of the dynamic response.

$\underline{\text{step } t=0}$: $\{p_{nl}(0)\} = 0;\ \{\dot{p}_{nl}(0)\} = 0 \Rightarrow \{\ddot{p}_{nl}(0)\} = [A]^{-1}\left(\{F_{h1}(0)\} - [C]\{p_{nl}(0)\}\right)$

$\underline{\text{step } t}$: $\{p_{nl}(t)\};\ \{\dot{p}_{nl}(t)\};\ \{\ddot{p}_{nl}(t)\}$

$\underline{\text{step } t+\delta t}$: It will be solved the linear equation system in $\{\ddot{p}_{nl}(t+\delta t)\}$:

$$\left\{[A] + [B]\frac{\delta t}{2} + [C]\left(\frac{\delta t}{2}\right)^2\right\}\{\ddot{p}_{nl}(t+\delta t)\} = \{F_{h1}(t+\delta t)\} - \{F_{h1}(t)\} +$$
$$+\left\{[A] + [B]\frac{\delta t}{2} - [C]\left(\frac{\delta t}{2}\right)^2\right\}\{\ddot{p}_{nl}(t)\} - [C]\delta t\{\dot{p}_{nl}(t)\} \tag{7}$$

$$\{\dot{p}_{nl}(t+\delta t)\} = \{\dot{p}_{nl}(t)\} + \left[\{\ddot{p}_{nl}(t)\} + \{\ddot{p}_{nl}(t+\delta t)\}\right]\frac{\delta t}{2};$$

$$\{p_{nl}(t+\delta t)\} = \{p_{nl}(t)\} + \{\dot{p}_{nl}(t)\}\delta t + \left[\{\ddot{p}_{nl}(t)\} + \{\ddot{p}_{nl}(t+\delta t)\}\right]\left(\frac{\delta t}{2}\right)^2$$

..... $\underline{\text{iteration } t = Ts}$

3 THE BARGE TEST SHIP MODEL FOR NUMERICAL AND EXPERIMENTAL ANALYSES

There are considered two models for the barge test ship, barge 1 (fig.1.a) in the case of frequency domain analysis and barge 2 (fig.1.b) in the case of time domain analysis of ship dynamic response, as there are defined in the Bureau Veritas report [5]. The segments of the barge model are interconnected by two elastic steel plates. The elastic plates have 50mm width and the thickness: 4mm in first case barge 1 and 6mm in the second case barge 2. The idealization of the input data for the barge models is presented in the table 1 [4]. The models inertial characteristics are considered uniform distributed over the ship length.

Table 1: Barge model characteristics

Model	Barge 1 (Fig.1.a)	Barge 2 (Fig.1.b)
Ne FEM beam elements	30	38
D.O.F. degrees of freedom	62	78
u_s [m/s] ship speed	0	0
Wave excitation	head, a_w=1, model Airy	no
L [m] ship length	2.445	2.445
B [m] ship breadth	0.600	0.600
D [m] ship depth	0.250	0.250
d [m] ship draft	0.120	0.120
d_{aft} [m] aft draft	0.120	0.11316
d_{fore}[m] fore draft	0.120	0.12691
c_B ship block coefficient	1.00	0.98
ρ [kg/m^3] water density	1000	1000
Δ [kg] ship displacement	176.04	172.53
b_s [mm] steel plate	50	50

Model	Barge 1 (Fig.1.a)	Barge 2 (Fig.1.b)
t_s [mm] steel plate	4	6
A_{fz} [m^2] shear area	3.333E-04	5.000E-04
I_y [m^4] bending inertial moment	5.333E-10	1.800E-09
μ [kg/m] mass per unit length	72.000	70.564
j_y [kgm^2/m] inertial mass / L	4.11E-06	1.39E-05
E [N/m^2] Young module	2.06E+11	2.06E+11
ν Poisson ratio	0.3	0.3
G [N/m^2] Transversal module	7.92E+10	7.92E+10
α=β structural damping	0.001	0.001
g [m/s^2] gravity acceleration	9.81	9.81
ρ_m [kg/m^3] material density	7.70E+03	7.70E+03
dx [m] FEM element length	0.0815	0.0815 / 0.0545 / 0.019

Table 2: The eigen circular frequencies of the barge test ship models [rad/s]

Model	Barge 1 (Fig.2.a)		Barge 2 (Fig.2.b)	
Analysis	wet modes	dry modes	wet modes	dry modes
$\omega_{heave, pitch}$	5.595	—	5.617	—
ω_{flex1}	3.117	4.623	5.771	8.579
ω_{flex2}	9.225	12.743	17.070	23.648
ω_{flex3}	18.818	24.982	34.810	46.358

In table 2 [4] are presented the oscillations and vibrations eigen circular frequencies values, based on the finite element method (1D-FEM), with Timoshenko beam elements [3]. In fig.2.a,b are presented the eigen modes at oscillations and vibrations for the two barge test models.

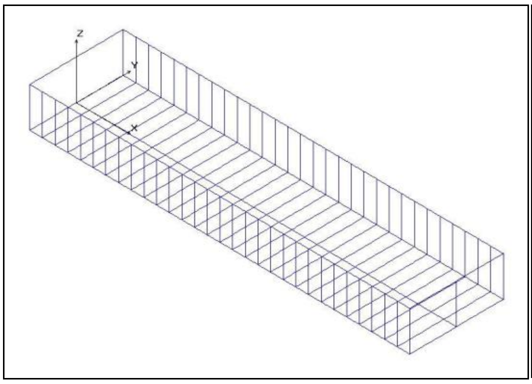

Fig.1.a: Barge 1 model

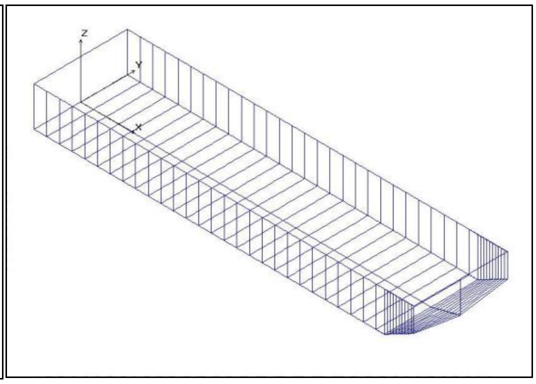

Fig.1.b: Barge 2 model

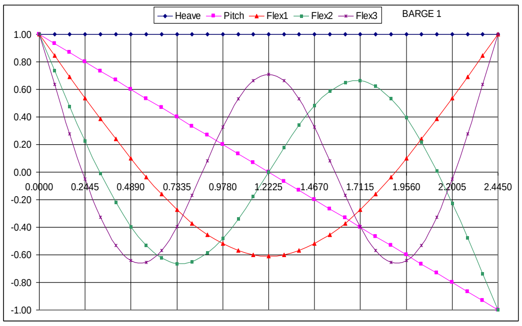

Fig.2.a: Eigen modes (dry), barge 1 model

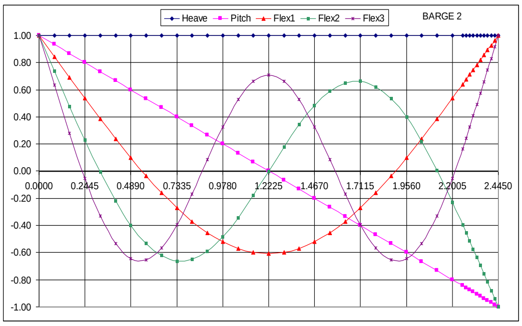

Fig.2.b: Eigen modes (dry), barge 2 model

4 THE FREQUENCY DOMAIN ANALYSIS OF SHIPS RESPONSE AMPLITUDE OPERATORS

Based on the theoretical model presented in chapter 2.1, are obtained the RAO functions for the total vertical displacement plus deformations and the principal modal coordinates (heave, pitch, the first three vibration modes), for the barge 1 test model. It is considered the linear modal analysis, in the case with zero ship speed, head wave model Airy [3]. The wave circular frequency domain is $\omega = 0 - 10\ [rad/s]$ and step $\delta\omega = 0.005\ [rad/s]$. In the following are presented the numerical results obtained with DYN [2] program, analyse module HEL:

- Fig.3 the RAO functions for the principal modal coordinates of barge1 model;
- Fig.4 the RAO function for the total vertical displacement and deformation of barge1 model, at the main section x=1.215m.

Based on the Bureau Veritas report [5], in the following we present the benchmark experimental and numerical results for barge 1 model, where are noted with UGAL our eigen numerical results:

- Fig.5.a,b,c the RAO functions for the principal modal coordinates of model barge1: heave, pitch and first vibration mode [4];
- Fig.6 the RAO function for the total vertical displacement and deformation of model barge1, at the main section x=1.215m [4].

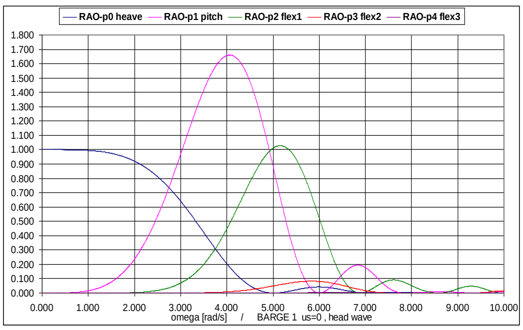

Fig.3: RAO for the principal modal coordinates

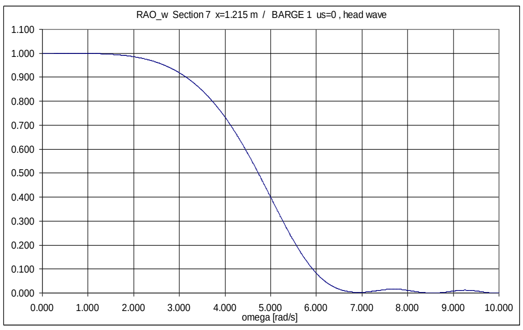

Fig.4:RAO total vertical displacement, x=1.215m

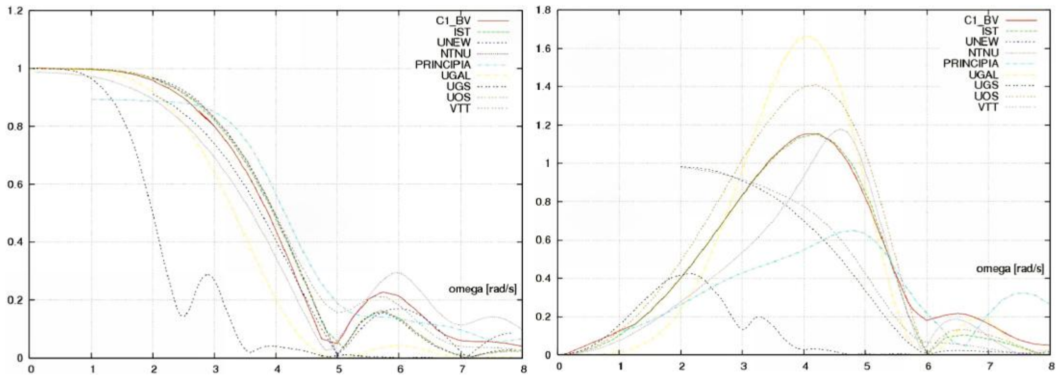

Fig.5.a,b: The RAO functions for the principal modal coordinates at heave and pitch [5]

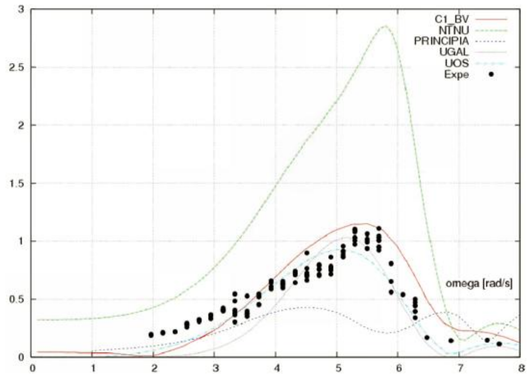

Fig.5.c: The RAO function for the principal modal coordinates at first vibration mode [5]

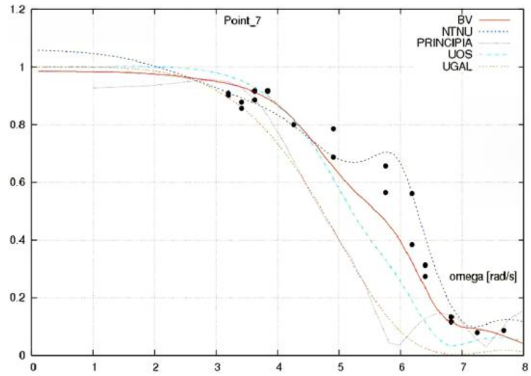

Fig.6: RAO function for the total displacement and deformation, at section x=1.215m [5]

5 THE TIME DOMAIN ANALYSIS OF SHIPS TRANSITORY RESPONSE

Based on the theoretical model presented in chapter 2.2, are obtained the time records of the total vertical deformations for the barge 2 test model.

According to Bureau Veritas report [5], the initial displacement conditions are obtained by pulling vertically the barge fore-pick to a prescribed level and then releasing the model by cutting the attached rope. In table 3 are presented the initial displacements from the experimental extinction test [5] and in table 4 are the calculated initial conditions in terms of modal principal coordinates.

In fig.7 is presented the initial experimental deformation of the barge girder. In fig.8 are presented the deformations of the barge girder at some time values t=0; 0.4; 0.75; 1.5 ;1.9 ; 3 s .

Table 3: Initial vertical displacements

No section S	x [m]	w(x,0) [mm]
1	2.445	101.90
3	2.035	51.08
5	1.625	14.23
7	1.215	-1.19
9	0.805	-6.27
11	0.395	-6.74

Table 4: Initial modal principal coordinates

Mode r	$p_{nlr}(0)$
0	0.0160677
1	-0.0459936
2	0.0305438
3	-0.0072541
4	0.0020409

In fig.9.a,b are presented the time records for transitory vertical displacement response, based on the numerical analyses. In fig.10.a,b are presented the time records for transitory vertical displacement response, based on the experimental analyses presented in the Bureau Veritas Register report [5].

The time records in fig.9.a,b and fig.10.a,b are non-dimensional, using the maximal value A=101.9mm.

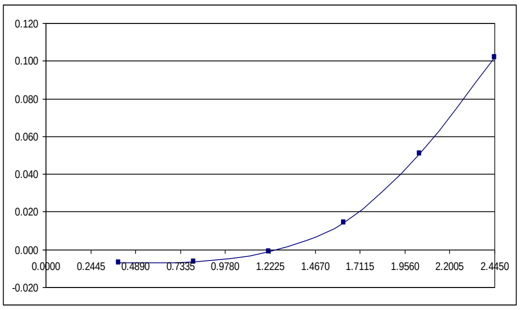

Fig.7: Initial experimental deformation [5]

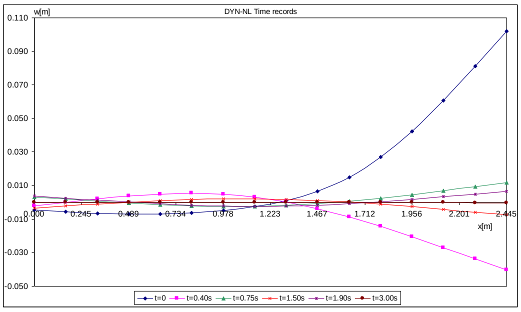

Fig.8: The calculated deformations

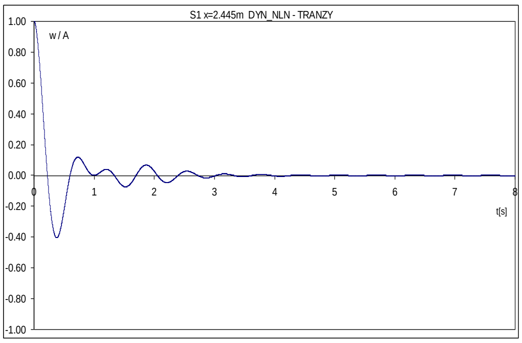

Fig.9.a: w/A time record , section S1

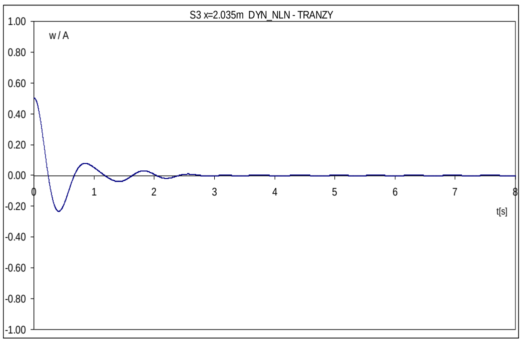

Fig.9.b: w/A time record , section S3

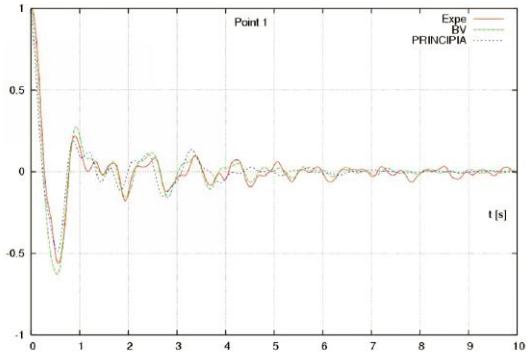

Fig.10.a:w/A time record, S1,experimental [5]

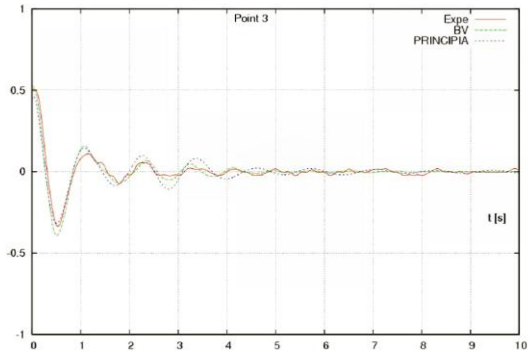

Fig.10.b:w/A time record, S3,experimental [5]

6 CONCLUSIONS

The numerical RAO functions obtained in this study, chapter 4, have very close values to those presented in Bureau Veritas report [5], for the total vertical displacement (with deformations) RAO_w and for the principal modal coordinates RAO_{pr} , r=heave,pitch,flex1,2,3 (see fig.3-6).

The numerical time records for transitory response of vertical displacements obtained in this study, chapter 5, are in good agreement with the experimental data presented in the Bureau Veritas report [5] (see fig.7-10). Because it results maxim deformation $w_{max} = 101.90\text{mm} < d_{fore} = 126.91\text{mm}$ then no impact-slamming occurs.

The differences between numerical and experimental results that occur have the following main sources:

- the precision of the input data idealization used in the tests;
- the structural damping coefficients are based on empiric values Johnson & Tamita [1] and further investigations have to be carried on;
- the eigen induced waves are neglected in the theoretical model and at the numerical analyses;
- method induced differences, because this study it is based on the 2D flow approach (strip theory).

ACKNOWLEDGMENTS

The work has been performed in the scope of the project MARSTRUCT, Network of Excellence on Marine Structures, (www.mar.ist.utl.pt/marstruct/), which has been financed by the EU through the GROWTH Programme under contract TNE3-CT-2003-506141

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THE MANAGEMENT AND MONITORING OF VIBRATION PROPULSION SYSTEM FOR THE BULKCARRIER

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Abstract: *In this workit is made a modal analyse, following by dynamic answer for the main parts like: propulsion system and the main shaft. This parts work in condition of vibration. The vibration measuring permit's to make models of the analysed parts that must correspond at characteristic frequency intervals. The experiments are made for bulk carrier of 55,000Tdw. After the experiments are choices the work optimal frequencies for the propulsion system of this type of ship.*

Keywords: *Bulkcarrier, vibration, propulsion, ship.*

1. INTRODUCTION

The main function of any ship engine is the propulsion. A propulsion unit consists of the machinery, equipment, and controls that are mechanically, electrically, or hydraulically connected to a propulsion shaft. After reading this chapter, you will have a basic understanding of how a ship's propulsion unit works. You will learn about the three main types of propulsion units used in the Navy. You will also learn how power is transmitted from the propulsion unit to the ship's propeller through the use of gears, shafts, and clutches. A ship moves through the water by propelling devices, such as paddle wheels or propellers. These devices impart velocity to a column of water and move it in the direction opposite to the direction in which it is desired to move the ship. A force, called reactive force because it reacts to the force of the column of water, is developed against the velocity- imparting device. This force, also called thrust, is transmitted to the ship and causes the ship to move through the water. The screw-type propeller is the propulsion device used in almost all naval ships. The thrust developed on the propeller is transmitted to the ship's structure by the main shaft through the thrust bearing (fig. -1). The main shaft extends from the main reduction gear shaft of the reduction gear to the propeller. It is supported and held in alignment by the spring bearings, the stern tube bearings, and the strut bearing. The thrust, acting on the propulsion shaft as a result of the pushing effect of the propeller, is transmitted to the ship's structure by the main thrust bearing. In most ships, the main thrust bearing is located at the forward end of the main shaft within the main reduction gear casing. In some very large ships, however, the main shaft thrust bearing is located farther aft in a machinery space or a shaft alley. The main reduction gear connects the prime mover (engine) to the shaft. The function of the main reduction gear is to reduce the high rotational speeds of the engine and allow the propeller to operate at lower rotation speeds.

In this way, both the engine and the propeller shaft rotate at their most efficient speeds. Various types and designs of prime movers are currently in use on naval ships.

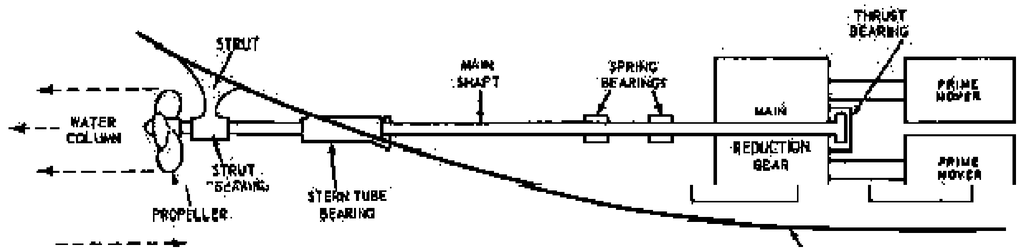

Fig 1.—General principle of ship propulsion.

2 MEASUREMENTS AND EXPERIMENTS

For all mechanical parts of action system are characteristic some frequencies like:

.- between 90 – 112 Hz for shipping bearing, reduction gear and the thrust bearing after engine;

- between 115 – 221Hz for main shaft, strut bearing.

This vibration is produced when the main engine is started and is amplified when the ship started to move and it necessary to change the course (way), or increase the speed ship.

There is a ununiformely charging of shaft, gear box, who are following in time by the fatigue of this parts and than their destroyed. The level (frequencies) of measurement vibrations in shaft line (the accelerometers are positions on the tube bearing and intermediaries bearings) was between 50 –135 Hz .At this vibrations are added another caused of external forces, gaps into the bearings (there is a pattern of wear who was study), and their average was 125 –265Hz.

For analyze the vibrations mechanism we can used the Finites element Method The system answer is seeing by analyzed the 3D mode of vibration, built after geometrical shape of ship propulsion system, using an calculus algorithm for each model.

3 THE MODEL OF RELATIVE DISPLACEMENT OF EACH POINT OF RESISTEANCE STRUCTURE

The models have four masses interconexion by three springs and two springs that make connexions between shell and bearings. This model give information's on the relative displacement of resistance structure when oven frequencie of propulsion system in faze with vibrations frequencies due the external forces in functions. The model show the displacement of main shaft line beyond the equilibrium position when the ship is in march.

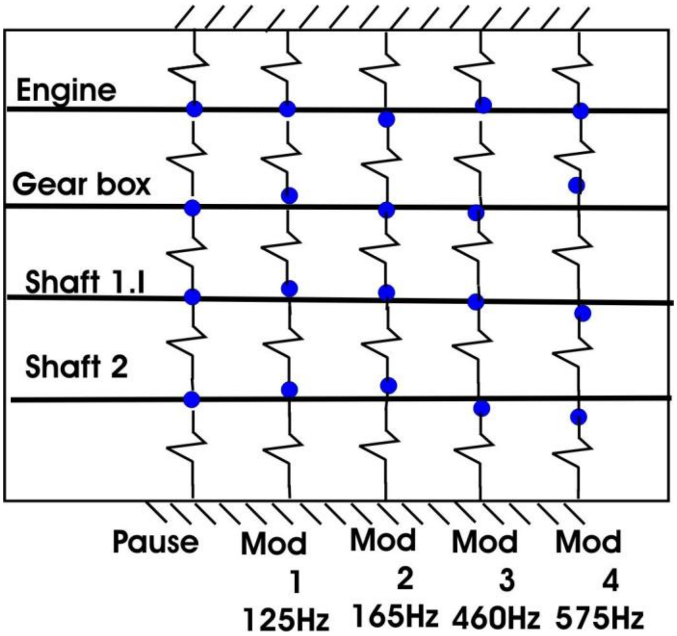

Fig. 2 .The Model with springs for the propulsion system.

4 THE ECUATIONS OF ELASTICS VIBRATIONS WRITTEN WITH RIGIDITY MATRIX

Without the effects of dumping on the system movement (c=0), we apply the D ”Alembert principle and we write the equations of moving of for the masses „mj” are:

$$\begin{cases} m_1\ddot{u}_1+k_{11}u_1+k_{12}\ddot{u}_2+k_{13}u_3=p_1(t) \\ m_2\ddot{u}_2 + k_{21}u_1 + k_{22}u_2 + k_{23}u_3 = p_2(t) \\ m_3\ddot{u}_3 + k_{31}u_1 + k_{32}u_2 + k_{33}u_3 = p_3(t) \end{cases} \tag{1}$$

Like matrix, this system can be write:

a) $[M]x\{\ddot{u}\} + [K]x\{\ddot{u}\} + [K]x\{u\} = \{p(t)\}$ (2)

b) $[M]x\{\ddot{u}\} + [C]x\{\ddot{u}\} + [K]x\{u\} = \{p(t)\}$

$\{\ddot{u}\}\quad\{\ddot{u}\}\quad\{p(t)\}$

$$[F] = \begin{bmatrix} \delta_{11} & \delta_{12} & \delta_{13} \\ \delta_{21} & \delta_{22} & \delta_{23} \\ \delta_{31} & \delta_{32} & \delta_{33} \end{bmatrix} \tag{3}$$

Where:

[M] –The inertial matrix of the system; [K] – The rigidity matrix of system; [C] –The dumping matrix of the system; {u}- The vector of displacement on the freedom degrees direction; {ii} – The vector of speed in the masses moving on the direction on freedom degrees; {ij} –The acceleration vector acceleration in masses moving on direction freedom degrees; |p(t)| -The vector of disturbances forces- pi(t). For a system with „n" freedom degrees. The matrix „M" it is a diagonal matrix like (n.x.n) and matrix „K" it is a symmetrically square matrix. The vectors are column matrix.

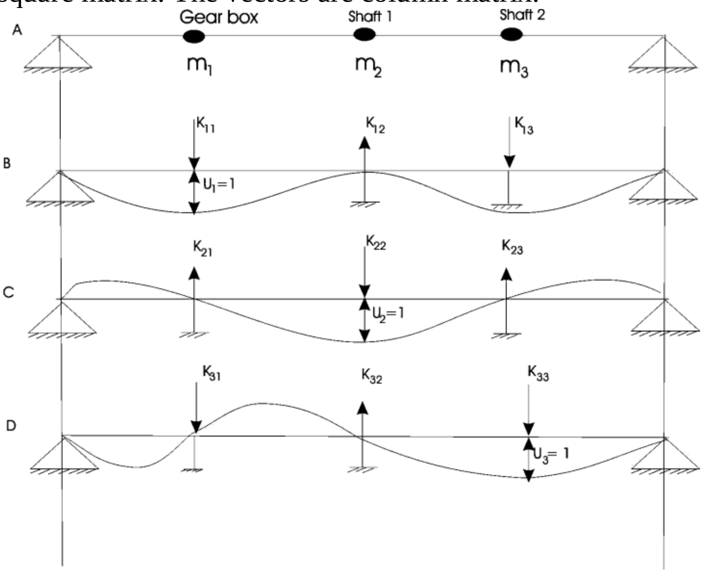

Fig.3. Elastics vibrations for the propulsion system

5 THE MODAL ANALYSIS METHOD TO DETERMINATE THE DYNAMIC ANSWER OF THE MAIN SHAFT

For the first date we determine the normal modes of vibrations throe self pulsations „xn" and the vectors of self forms of vibrations:

|(j)j }(j = 1,2,3,...n)

The second we calculed the dynamic answer for the "j" modulus of vibratoin (the displacement):, Uj(t)j on the directions of freedom degrees, the tensions in the structure sections"x": Mj(x,t), N.(x,t), Tj (x,t), the tensions Oj, tj, etc. (j=l,2,3, ...n);

$$\{\phi_j\}(j = 1,2,3,...n)$$

$$\{u_j(t)\} = \begin{Bmatrix} u_{1j}(t) \\ u_{2j}(t) \\ \vdots \\ u_{ij}(t) \\ \vdots \\ u_{nj}(t) \end{Bmatrix} \qquad \{\phi_j\} = \begin{Bmatrix} 1 \\ u_{2j} \\ \vdots \\ u_{ij} \\ \vdots \\ u_{nj} \end{Bmatrix} \quad \{a_j\} = \begin{Bmatrix} a_{1j} \\ a_{2j} \\ \vdots \\ a_{ij} \\ \vdots \\ a_{nj} \end{Bmatrix} \tag{4}$$

$$\{u_j(t)\}; \qquad u_{ij}(t) = a_{ij} \sin(\omega_j t - \varepsilon_j) = \alpha_j \phi_{ij} (\omega_j t - \varepsilon_j)$$

|uj(t)j – the displacement vector on direction of freedom degrees for "j" vibration modulus:

$$u_j(t) = a_j \sin(\omega_j t - \varepsilon_j) = \alpha_j \phi_{ij} (\omega_j t - \varepsilon_j) \qquad (j = 1,2,3,...n) \tag{5}$$

Ujj(t) – displacement on direction "i" in time of "j" modulus of vibration.
a; = *ay.*, amplitude on direction "1" in time of "j" modulus of vibrtion .

$$\{u(t)\} = \sum_j \{u_j(t)\} \qquad M(x,t) = \sum_j M_j(x,t) \tag{6}$$

- The total dynamic answer is obtained by apply the principle of added of all answers of normal modes of vibration:

$$[M] \times \{\ddot{u}(t)\} + [K] \times \{u(t)\} = 0 \tag{7}$$

When the structure is moving from equilibrium position throe initially speed and displacement, this structure execute free vibrations if does not existing dumping.

$$\{u_j(t)\} = \{a_j\} \sin(\omega_j t - \varepsilon_j) = \alpha_j \{\phi_j\} \sin(\omega_j t - \varepsilon_j) \qquad (j = 1,2,3,...n) \tag{8}$$

Differentially equation accept „n” particularly solutions in correspondence with „n” normal vibrating modes like :

$$\{u_j(t)\} = = \sum_j \{u_j(t)\} = \sum_j \{\phi_j\} \{\alpha_j\} \sin(\omega_j t - \varepsilon_j) \tag{9}$$

General solution of differentially equation (1) is obtain like a lineally combination of “n” particularly solutions and is in dependence of “2n” integrity constants
At last the generally solutions will be:

$$\{u(t)\} = \sum_j \{\phi_j\} \cdot \eta_j(t) = \{\phi_1\} \cdot \eta_1(t) + \{\phi_2\} \cdot \eta_2(t) + ... + \{\phi_n\} \cdot \eta_n(t) \tag{11}$$

where [(j)] is |(j)j j(j = 1, 2, 3,...,n) and is named modal matrix. At each normal mode of vibrating „j” we can associate a inertial forces system. Finally this system, (M°(x), $T^0(x)$, N°(x), deform the structure after his owen shape

6 CONCLUSIONS

After ten round of vibration measurement we find the next gap of frequencies: - between 6Hz and 92 Hz caused by coupling and gear box; between 122Hz and 287Hz, whose cause are the gap into the bearings because of wear who is produce by different cause. We proposed a monitoring and alarm system with accelerometers mounted on the main bearings.

The monitoring system work by using the comparing between an initially signal and the signal obtained in while of ship displacement. The final purpose is to realise the concept of „prediction maintenance „in while of function of the ship, the increase of friability of propulsions system.

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PERFORMANCE MODELLING OF A MICRO JET ENGINE WHO WORK IN MARINE ATMOSPHERE

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Abstract: *In this paper we propose to study the problem of obtaining a micro jet engine maximal performance that works in marine environment and influence of atmosphere to micro jet engine performances. The environments are advantage and disadvantage in jet engine work and life duration of his components. The performances modelled are thrust force and specific fuel consumption.*

Keywords: *marine, engine, turbojet.*

1 MARINE AIR CHARACTERISTICS

Clime physiognomy: Continental clime with strong coast influence. The zone with the warmest winter from country – situated on 0ºC isotherm. The medium year temperature is 11.2ºC. The smallest number of frost days: 70.6. The medium relative air humidity: 84%, the best from country. Maximum humidity: 90%, in December mount. The great humidity on could season, November, January, February mounts - 88%.

The characteristics of sea water (1973): salinity 15,7 g/l, oxygen 8,8 mg/l, transparency 4 m, phosphorus 13,7 mg/m3, silicium 1870 mg/m3, N 81,8 mg/m3, oxidability of solved organics substances 2,23 mg O2/l, pH 8,2.

The principal components of salinity are NaCl, aproximatively 80% from total substances, by with still six solved solid corps, in small dose.

That is $MgCl_2$ and Mg, Ca, K sulphate, $CaCO_3$, bromide of Mg. If Na, Mg, Ca, K and Br, by chore, sulphats, bicarbonate, strontium and baric acid (710 mg-l) are the major components of sea water. This water contains other components which are in very small proportion. Their represent the minor components of sea water: I, F, Ag, Au, Si, nitrates, phosphates, etc.

The major components have the mass of 10 mg at 1kg sea water. These are Cl, Na, SO, Mg, Ca, K, the bicarbonate, the bromine, the strontium and the baric acid.

Since in the sea water the quantity of cat ions (Na, K, Mg, Ca, Sr) are more highly than of anions (Cl, Br, F, SO42, bicarbonate, baric acid), these waters present alkaline reaction (the normal pH=8,2).

2 MICRO TURBOJET ENGINE IN MARINE ENVIRONMENT

Among the propulsion systems used in marine atmosphere there are those on vehicles that move on sea or on air. We can enumerate the piston engine wit spark plug, the turbojet engine, the turbo shaft power plant, the steam turbine engine and the Diesel engine.

As spreading, on commercial ships are used steam turbine for high power and diesel engine and turbo shaft power plant for medium and low power.

As a ship engine the turbo shaft power plant is framed in power field between 147 kW-91.500 kW (at the 1960 year).

The turbo shaft engine used in terrestrial installations can be used on boats, since are specific fuel consumption about 0.28-0.31 kg/kWh and are sufficient compact (specific volume are under 0.3 m^3/kW).

The specific fuel consumption and effective efficiency place turbo shaft engine between steam turbine engine and diesel engine (as Table 1)

Table 1 The type of engine

Engine type	Specific fuel consumption kg/kWh	Effective efficiency
Steam turbine	0.37-0.48	0.22-0.26
Turbo shaft power plant	0.27-0.35	0.26-0.29
Diesel	0.224-0.25	0.32-0.35

The cost of fuel used depends on the engine's type, choosing of an engine type is established by other factors like the wear of engine components, etc. The turbo shaft power plant has the maintenance cost inferior to the steam turbine engine how and Diesel engine of high power. In addition turbo shaft engine is more compact, has a low specific mass, needed little number of maintenance personal and short time of reparation and revision, fast started.

A propulsion installation with micro turboshaft engine is composed by compressor, heat recuperator, burn chamber, turbine, exhaust nozzle. From the recuperator cause, the specific mass of installation may be disadvantage comparative with specific mass of Diesel engine. Also if is high losses on fluid engine pass, then fuel consumption is high. The temperature in front side of turbine is reduced at 650ºC - 850ºC, it is imposed by the wear of turbine blade, owing to mineral substances from ash of used fuel and missing a method to combat this.

In military ship case the turbo shaft power plant engine may be used. For the cruise regime where the fuel consumption is matter, the turbo shaft engine cooperate with other engine type without a net distance from each other with exception of high power engine domain and like maxim power propulsion system where diesel engine is to heavy over 13 kg/kW, and the turbo shaft engine present net advantage by compact and light installation. The steam turbine have a specific mass of 8.7 kg/kW as turbojet engine adapted like boat engine with short time of running have 0.93 kg/kW and the turbo shaft engine with long time of running and high efficiency have 3 kg/kW. Since must reduced the engine mass, mass flow and volume the temperature in front side of turbine must increase at 750ºC-800ºC. In the same time is necessary to increase the flow velocity and reduced the length of flow channels for to reduce friction losses and installation dimensions. The adaptation of turbojet engine like boat propulsion engine may be realized as max speed engine of ship and unshipping through substitute of exhaust nozzle with free turbine which drives the ship helix. The compression ratio of this type of engine is low 5-6 for to hobble work in inverse flow zone. The turbo shaft boat engine with the power ≤ 100 kW may be considerate micro turbojet engine owing to dimension reduced. This may be used for propulsion of boat if substitute of exhaust nozzle with free turbine which drive the boat helix.

The modified turbojet needed high mass flow (22-31 kg/kW) in comparison with the others two type of engine, in this way she needed high dimension channels (steam turbine 8.7 kg/kWh and the diesel engine under 7 kg/kWh).

In micro turbojet case used for to drive the helix of boat the power is between 2.7-30 kW, mass flow breath vary between 0.25-1 kg/s, and specific fuel consumption between 0.9-1.8 kg/kWh (because losses in the engine increased)

For increased the life of engine components must smaller temperature in front side of turbine and increased compression ratio.

The application of micro jet engine and micro turbo shaft engine is may be enumerate like boat propulsion (Rover Motor T8), emergency engine (Artouste 1), emergency generator (W.H. Allen Emergency G.T.A.). Through applications of micro turbojet engine from point of view of aerial vehicle propulsion may be mini cruise missile, aerial target, drone, aerial decoy, cargo bombs.

3 PERFORMANCES OF MICRO TURBOJET ENGINE IN MARINE AIR

The admission of moist air in compressor may lead at a substitution process of adiabatic evolution with polytrophic evolution. The vapors from engine air breath are may overt heats consumption a lot of heat.

Using a micro turbojet engine with mass flow 0.5 kg/s and a scale compression ratio 2,3,4,4.5,6,7,8; the temperature in front side of turbine 1100 K and choosing the efficiency in usual domain of jet engine, may be established the variation of thrust force and specific fuel consumption versus compressed ratio. We obtain the following variation from Fig1 and Fig.2 at zero altitude and speed and Fig 3 and Fig. 4 at zero altitude and 200 m/s flight speed.

The effect of air moist breathing increase with increase of air temperature or with increase of flight speed.

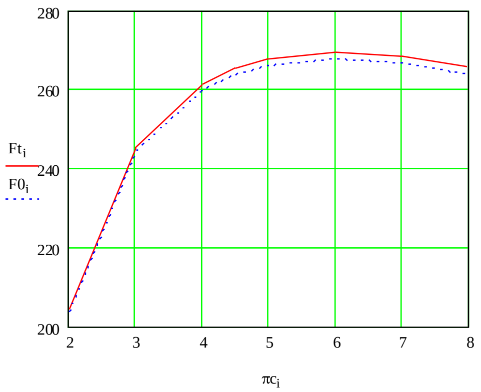

Fig.1. The variation of thrust force versus compresed ratio at admision of dry air , F0 and admision of moist air, Ft.(0m altitude, 0m/s speed)

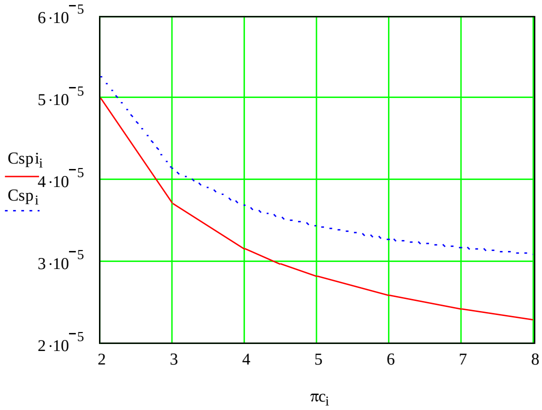

Fig.2. The variation of specific fuel consumption versus compresed ration at admision of dry air, Csp and admision of moist air, Cspi. (0m altitude, 0m/s speed)

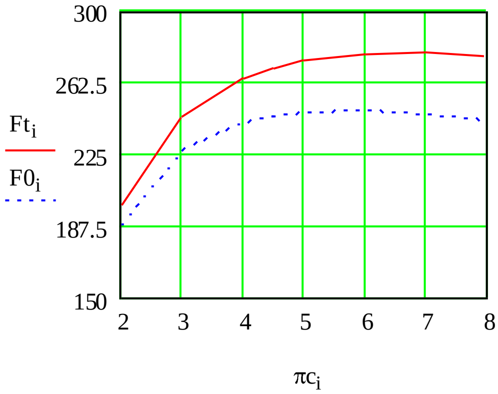

Fig.3. The variation of thrust force versus compresed ratio at admision of dry air , F0 and admision of moist air, Ft.(0m altitude, 200m/s speed)

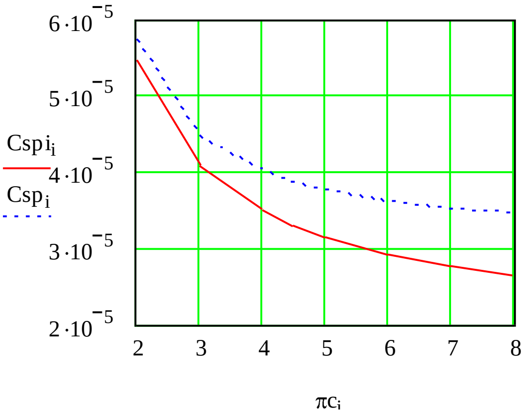

Fig.4. The variation of specific fuel consumption versus compresed ration at admision of dry air, Csp and admision of moist air, Cspi. (0m altitude, 200m/s speed)

4 MARINE ENVIRONMENT AND ENGINE COMPONENTS

The marine environment action to engine components by corrosive action of various inorganic and organic compound as and through microorganisms from fuel and air breath in motor. The components of micro turbojet engine are manufactured from

metallic materials but after year 1990 is realized with entire or a part of micro turbojet from composite materials.
The corrosion of engine components is realized by individual or compound action of compound and chemical elements.

The Mineral and organic acid corrode electrochemical in water presence diversely metals Ni, Fe, Mn, Zn, Sn, Al and less Cu and him alloy. The mineral acid are to corrosive and it imposed shortage from fuel-air mixture.

The excess of oxygen from gas flow of engine at high temperature can corrode iron alloy accordingly the steel is alloyed with Cr, Al, Si, Ni. The oxygen solved in fuel tank water may corrode feeble steel alloy.

The metallically compound sodium in special even in reduced in gas flow may produce corrosion of turbine blade and other engine parts. This may be contained in fuel, contain of Na is limited by STAS 5639-77 at 0.1 ppm. In addition the action of chemical compound from marine air to the engine parts, action and other chemical reaction product from fuel – air mixture. These products (vanadium oxide) at high temperature (600ºC) may be oxidation catalyst for others elements contained in gas flow like SO_2 and SO_3 and can lead to corrosion of turbine blade.

The black canker it fact finding as if is injected a saline solution with water sea composition in engine airflow for combustion process then it observe evolution of black canker and intensification of corrosion (Fig. 5).

water sea → black canker → dimple → fissure

Fig. 5. The black canker evolution

Also the moisture from air breath engine is an electrolytic environment for chemical compounds like flaw from gases flow resulting strong corrosive acid. The brimstone combined with mechanical stress may produced corrosion and destroy the nickel alloy. The flaw from gases may generate at high temperature destruction of combustion chamber. This combat by rise contained of Cr or application of a layers from Cr, Al or Ti, thus is avert appear of black canker.
But, in case of used engine in a marine air the fuel and lubricants may be contamination with water. In the second case the indicated lubricant is a viscous compound with wax, anticorrosion who create physical hedge maid water. In neutral or acid media, the aluminum preset good corrosion resistances.

The Aluminum is responsive with oxygen from air. The packs of oxide layer are some hundredth mm, is very resistant and protect the metal by corrosive agents.
The best resistances of aluminum alloy are in scale of a pH 4-6. The usual acid has the pH in scale 4-5. The aluminum – magnesium alloy have a good resistance in corrosive environment, alkaline and salted (water sea), organics substances, moisture air. The problem of this alloy is the low melting temperature. This alloy is used to manufacturing compressor shape and inlet nozzle.

The AlMg alloy present a high resistance at corrosion in sea water and feeble alkaline solution and AlMgSi present a high resistance at caustic embitterment and a good stability in sea water and used in onrush industry.

Among metallically materials used in engine manufacturing are:
- Aluminum alloy at centrifugal compressor and inlet nozzle;
- High steel alloy with nickel and chrome at engine shape and shaft;
- Nickel alloy with low Fe content at turbine blades;
- Cobalt alloy at combustion chamber and turbine blades.

5 ADVANTAGE AND DISADVANTAGE OF MARINE AIR FOR MICRO TURBOJET ENGINE

The advantage of marine environment in micro turbojet engine functioning and like propulsion system for aerial vehicle is may be the rise of thrust with 10 % owing to high humidity of air, in case of aspirate air temperature between 30 ºC-50 ºC.
In case of used of engine like propulsion system for a boat or through her transform in turboprop engine the rise of thrust is about 25 % for a large scale of aspired air temperature.

The disadvantage of marine environment in micro turbojet functioning is the direct corrosive action of environmental factors with metallically engine component. These factors are organics and inorganic chemical compounds, air moisture, microorganisms.

Also through corrosion is affected the turbine efficiency and pressure loose in inlet and combustion chamber.

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THE NEED OF CONTINOUS COP CALCULATION FOR LARGE REFRIGERATION PLANTS

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Abstract: *Food preservation has been the main refrigeration application for more than one century. Nowadays greater and greater use is being made of refrigeration for other perishables. Nevertheless, the frozen food sector is still expanding and chilled food may take an even larger place. The refrigeration technology is indispensable also on board the ship, not only for the reefers. Without it, healthy meals and comfortable living conditions would not be possible. This paper deals with continuous direct and indirect calculation of COP (coefficient of performance) for large refrigeration plants. This calculation is useful for the determination of loss in cooling capacity, mechanical faults and energy optimization of single compressors refrigeration plants and complex systems with more than one compressor.*

Keywords: *refrigeration, cop, plant.*

1 INTRODUCTION

Food preservation has been the main refrigeration application for more than one century.

More and more products are kept in cold stores. Films and various other photography products, grafts and other biological materials or flowers are just a few. Flowers and other ornamental plants may represent the largest and fastest growing sector of this market. The transportation of flowers has become an important part of the air and even the sea transport market.

Referring to cold stores, comparison of cold store volumes per inhabitant show the huge potential for development.

Distribution is an area where special refrigeration equipment is taking on more and more value and is changing very rapidly. Markets, shops and supermarkets are places where consumers decide whether to pay price for cold storage or not. It is not justified the restrict the advantages of refrigeration at this final part of the cold chain. This is why many companies have developed refrigerated display cabinets.

The cold chain does not stop at the sale of the product. Household refrigeration is the latest step in the life of the product.

The second large area where refrigeration is being used is air conditioning. Air conditioning has been expanding in two directions: warm/humid countries, where it is considered as an essential tool for development and more temperate countries, where it is considered as a sign of high standard of living.

Also, most railways, buses or metros have introduced or are planning to introduce air conditioning, even where hot days are very few. There are a lot of other areas where refrigeration is more and more required. LNG production is dealing to many new plants and gas carriers. Refrigeration is needed for LPG but seems to be less innovating.

In addition to air conditioning/heating systems, heat pumps are being used in more and more cases.

The development of the cold chain depends very strongly on transport. Most refrigerated products will be transported several times between production and use. Each transport is a risk for the cold chain.

Ships are foreseen with refrigerating plants able to preserve food on board, and with air conditioning plants. Besides above mentioned, reefers have refrigeration plants able to assure goods transportation at low temperatures. There are reefers specialized to transport frozen food (meat, fish) and chilled food (bananas, cheese, wines, etc.)

Being seen the main uses of refrigeration, the sustained increase of frozen food production and the potential of chilled food, the rise in air conditioning use in the world, it is need to analyze and optimize these plants.

2 ABOUT THE SINGLE STAGE REFRIGERATOR

Figure 1 depicts a typical single stage vapor compression system.

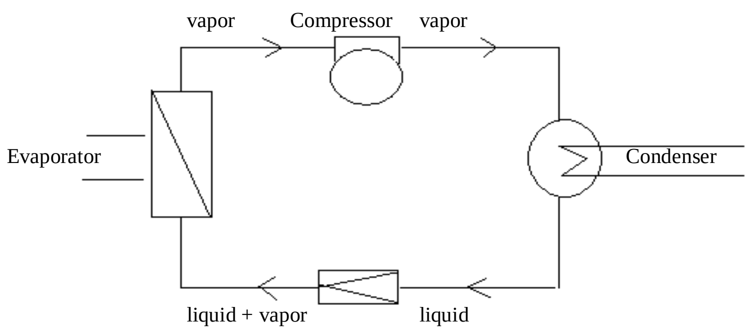

Fig.1: Vapor compression refrigeration

As seen, it contains four components: a compressor, a condenser, an expansion valve (also called a throttle valve) and an evaporator.

Circulating refrigerant enters the compressor in the thermodynamic state known as a saturated vapor and is compressed to a higher pressure, resulting in a higher temperature as well. The hot, compressed vapor is then in the thermodynamic state known as a superheated vapor and it is at temperature and pressure at which it can be condensed with typically available cooling water or cooling air. That hot vapor is routed through a condenser where it is cooled and condensed into a liquid by flowing through a coil or tubes with cool water or cool air following across the coil or tubes. This is where the circulating refrigerant rejects heat from the system and the rejected heat is carried away by either the water or the air.

The condensed liquid refrigerant (saturated liquid) is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. That pressure reduction results in the adiabatic flash evaporation of a part of the liquid refrigerant. The auto refrigeration effect of the adiabatic flash evaporation lowers the temperature of the liquid and vapor refrigerant mixture to where it is colder than the temperature of the enclosed space to be refrigerated.

The cold mixture is routed through the coil or tubes in the evaporator. The evaporator is the place where the circulating refrigerant absorbs and removes heat which is subsequently rejected in the condenser and transferred elsewhere by the water or air used in the condenser.

To complete the refrigeration cycle, the refrigerant vapor from the evaporator is again a saturated vapor and is routed back into the compressor.

Applications of this type of plant are seen in Table 1

Table 1: Applications

Refrigeration application	**Short description**	**Typical refrigerants used**
Domestic refrigeration	Appliances used for keeping food in dwelling units	R600a; R134a
Commercial refrigeration	Holding and displaying frozen and fresh food in retail outlets	R134a; R404A; R507
Food processing and cold storage	Equipment to preserve process and store food from its source to the wholesale distribution point	R134a; R407C; R410A; R507
Industrial refrigeration	Large equipment, typically 25 kW to 30 MW, used for chemical processing, cold storage, food processing and district heating and cooling	R134a; R404A; R507; R717
Transport refrigeration	Equipment to preserve and store goods, primarily food stuffs, during transport by rail, air and sea	R134a; R407C; R410A
Electronic cooling	Low – temperature cooling of CMOS circuitry and other components in large computers and servers	R134a; R404A; R507
Medical refrigeration		R134a; R407A; R507
Cryogenic refrigeration		Ethylene, Helium

It is benefic to equip larger industrial and commercial refrigeration plants for continuous COP monitoring and fault diagnosis in order to achieve energy savings and lowering maintenance costs by measurements of the changes in performance.

3 COP CALCULATION

The coefficient of performance for a cooling compressor plant is given by:

$$COP = \frac{\text{ø}_0}{P_K} \tag{1}$$

Where: ø_0 = the cooling capacity, [kW]

P_K = power consumption of the compressor, [kW]

DIRECT COP CALCULATION

$$ø_0 = Q_m(h_1 - h_4) \tag{2}$$

Where: Q_m - mass flow of the refrigerant, [kg/s]

h_1 – refrigerant enthalpy at the inlet of the compressor, [kJ/kg]; $h_1 = h_1(p,T)$

h_4 – refrigerant enthalpy at the inlet of the evaporator, [kJ/kg]; $h_4 = h_3(T)$; h_3 – the enthalpy of the refrigerant after the passage of the condenser, [kJ/kg].

In order to determinate the mass flow of the refrigerant it is needed to measure the volume flow of the working fluid after the passage of the compressor, V_2 (m^3/s), and to calculate the specific volume of the working fluid after the passage of the compressor, v_2 (m^3/s).

So:

$$Q_m = \frac{V_2}{v_2};\ v_2 = v_2(p,T) \tag{3}$$

Determination of enthalpy increase the compressor and of enthalpy decrease across the condenser is done by measuring temperature and pressure after the compressor in the inlet pipe to the condenser.

$$h_2 = h_2(p,T) \tag{4}$$

h_2 – refrigerant enthalpy after the passage of the compressor, [kJ/kg].

In Figure 2 are shown the measuring points. Are indicated positions of measuring points: transducers for temperature, pressure, volume flow and power consumption.

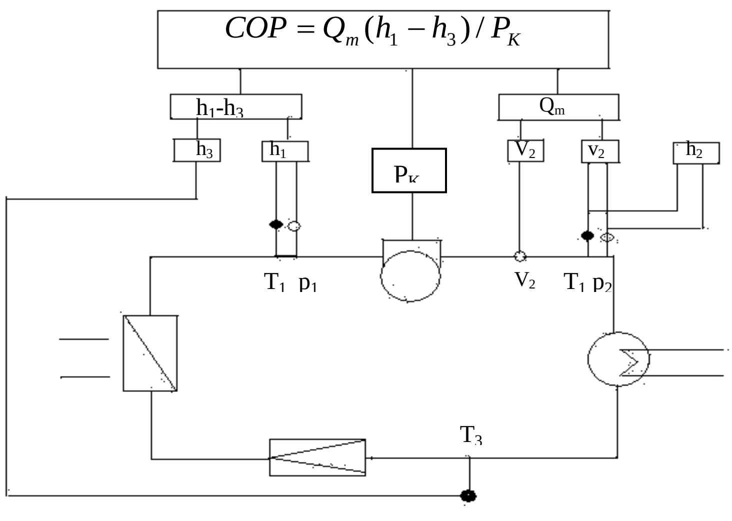

Fig.2: COP determination by direct calculation

INDIRECT COP CALCULATION

For this calculation is needed the determination of the cooling capacity on the secondary side of the evaporator.

$$ø_0 = Q_W C(T_i - T_e) \quad (5)$$

Where: Q_W – mass flow of the cooling media through the evaporator, [kg/s];

C – specific heat capacity, [kJ/kgK];

T_i – temperature of the cooling media at the inlet of the evaporator, [K], [^{0}C];

T_e – temperature of the cooling media after the passage of the evaporator, [K], [^{0}C];

In Figure 3 are shown position of measuring points: transducers for temperature, pressure, volume flow and power consumption.

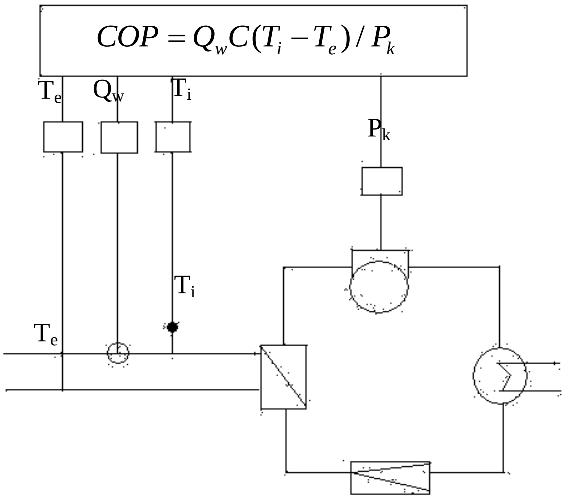

Fig.3: Indirect COP calculation

4 CONCLUSIONS

The continuous calculation of COP for larger refrigeration plants is a tool for identification of loss in cooling capacity, mechanical faults and energy optimization of single compressors, refrigeration plants and complex systems with several compressors. Direct COP calculation makes possible the evaluation of the system COP and performance of the separate components of the refrigeration plant (compressor, condenser and evaporator). Indirect COP calculation allows only the evaluation of the overall performance of the installation by its COP.

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MODERN METHOD TO ESTIMATE THE PRESENT POSSIBILITIES TO DIMINISH THE WEAR PHENOMENON

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Abstract: *The wear represents the degradation of an object by continuous use and it represents the main deterioration factor for the parts and the subassemblies of the technical equipments. This paper represents an important accumulation of individual studies, information and experience, as it is an important step in the technical and didactic improvement, regarding the study of the wear phenomenon and choosing the most advanced and modern methods and procedures to recondition the surfaces of the parts intensely submitted to wear. This paper is organized in four chapters and it contains general aspects regarding the parts' friction and wear, the factors influencing the parts' wear, the improvement of the quality of the parts' surfaces by applying heat treating and by presenting the modern method to estimate the present possibilities to diminish the wear phenomenon.*

Keywords: *method, wear, phenomenon.*

1 GENERAL ASPECTS REGARDING THE PARTS' FRICTION AND WEAR

During the functioning, the parts wear out under the influence of various factors and this is the main cause for their failure.

The wear is a complex, destructive phenomenon, of physical and chemical nature, leading to the undesirable and progressive loss of material on the solid surfaces of the parts in friction, accompanied by the modification of the dimensions, the geometrical form and the quality of the surfaces, as a result of the interaction of the parts and of the actions of the external agents.

Besides the modification of the geometrical dimensions, the forms and the weight of the parts, during the vehicles' operation there are also modified the properties of the surface layers of the parts. For example, the hardness of the surface of some parts decreases in the first stage corresponding to the wear evolution, and subsequently the hardness increases as a result of the hardening, causing a gradual increase of the fragility of the surface layer, which accelerates the rate of wear.

The modification of the dimensions and the geometrical form of the parts causes the modification of the initial adjustment of the assemblies, with negative consequences on their good functioning.

The main causes for the wear of the parts are the friction, the plastic deformations of the material, the material fatigue and the thermal and chemical action on it.

1.1 Friction

The friction phenomenon is known from the oldest times. Based on the tribological studies it resulted that the frictional force represents a resultant of several compounds generated at the detrusion of some micro-wildings of the micro-asperities of the metallic material or for defeating the resistances to the displacement and the scratching tendency of surfaces by the abrasion products, the production of the local elastic or plastic deformations and the defeating of the adherence forces at the micro-surfaces in direct contact and the defeating of the resistance of the lubricant film to detrusion.

From the point of view of the functioning of the subassemblies, besides the prejudicial effect presented above, the friction can sometimes be also useful, as in the case of couplers, brakes, variators for friction etc.

The functioning of the technical equipments implies the existence of various combinatio0ns, of certain friction regimes in the present of a lubricating environment, defined as the fluid friction, the friction limit, the mixed friction, the dry friction and the elastic and hydrodynamic friction.

1.2 Wear of parts – wear types

The friction process has as a result the loss of energy and the wear. Generally, it is accepted the classification of the wear in four types, which can appear both at the dry friction and also in the presence of lubricants, as an adherence, abrasion, fatigue and corrosion wear. In practice, these types are met separately only in special cases.

2 THE FACTORS INFLUENCING THE PARTS' WEAR

The characteristics of the wear depend on a big number of factors of constructive nature, on the manufacturing and the operation and they are influenced by the quality of materials and of the heat treatments of surfaces, of fuel and of lubricant, on the specific pressures, on the relative speeds and on the clearance of the surfaces in movement. The resistance to wear of these parts is very much influenced by the way in which these factors are taken into account at the design, the manufacture, the operation and the repair.

2.1 The quality of the material and its structure determines the resistance and the hardness of the parts

This is why, when choosing the materials for the manufacturing of the parts there must be considered both the resistance to breaking within the part's operation conditions and its resistance to wear.

The high hardness of materials on the surfaces in contact leads to the diminution of wear. The high resistance to wear of the parts with high hardness is explained by the fact that, in this case, the action of the abrasive particles, as well as that of the plastic deformations, is much reduced.

The chemical composition of materials also influences their resistance to wear. Thus, in the case of steels, the marten site structure formed of small crystals has the biggest resistance to wear. The cast iron with perlite structure has a resistance to wear 1.5 …. 2 times bigger than that with ferrite structure and the babbitt with small granulation is more resistant to wear than the babbitt with big granules. The structure desired can be obtained by submitting the metallic material to an adequate heat treatment of normalization, hardening, restoring, annealing, etc.

For the good functioning of an assembly and to increase its resistance to wear, it is more important to execute the parts of different materials regarding their hardness and tenacity. For a pair of parts working together it is not recommended to use identical materials, with the same hardness. The most complicated part from the point of view of the building, the manufacture or the repair, so the most expensive one, must be performed of a material of higher quality, which must provide it a big resistance to wear, which is imposed by the mating member.

The quality of surfaces has a big influence on the resistance to wear and it is determined by their mechanical treatment. The parameters characterizing the quality of the surfaces' treatment are macro-geometry and micro-geometry parameters. The macro-geometry parameters characterize the deviations of the real shape of the surface from the ideal geometrical shape (deviations from parallelism or the perpendicular, conical, oval characteristic etc.). The micro-geometry parameters characterize the finishing degree of the parts' surfaces. By means of treatment there are produce changes and modifications in the structure of the surface layers of the metallic materials. The finishing of the treatment is made by rectification, polish, lapping, etc. but, not matter how precise the treatment method is, the surfaces obtained shall present some treatment marks (asperities). In the case of the coarse surfaces, the oil film often breaks, producing semi-liquid frictions, intensifying the wear of the surfaces in friction.

The roughness degree also depends on the fatigue of the parts. The more a surface is cleaner, the less it wears. Still, at a too big surfacing, (for example the polished or the furbished surfaces), the lubricant is retained less and, in the case of loads bigger than those for which there was made the dimensioning it is possible that the working surfaces come in contact and that the wear intensifies. Moreover, obtaining some surfaces with a high level of surfacing implies bigger expenses, which are not always justified.

The height of asperities diminishes by lapping; there appears new roughness, with a new shape, the direction of which is in the direction of movement of the parts in friction. After the lapping, there is performed a optimum roughness, which does not depend on the initial roughness (after the treatment), as it can be thinner or rougher than the last one.

2.2 The quality of the fuel and of the lubricant influences the wear degree of the parts in the composition of engines

A fuel which evaporates hard and which condensates, fluidizes the lubrication oil and it increases the wear degree of the surfaces in friction. The condensation phenomenon of the fuel is very pronounced when starting the engine, when it is cold.

The fuel, by the nature of the roast gases, influences the corrosion wear. This one is also influenced by the fuel mixture. The poor mixture produces roast gases with accentuated corrosive action.

The lubrication exercises a very big influence on the wear process. A good lubrication must be made by a certain separation of the surfaces in friction, to insure their cooling, to be neutral from the chemical point of view and not to contain mechanical impurities. The different materials of the parts are a different conduct from the chemical point of view regarding the chemical compounds of the oils and greases. This is why, when choosing the additive oils there must be considered the susceptibility of the metals at the chemical action of the additives. For example, the bronze is attacked by cyanides; the plumb and the cadmium are dissolved in soaps and the fatty acids reaction with several metals such as the zinc, the copper and the iron. The lubrication oils must have the corresponding viscosity, fattiness, chemical stability and they must not contain mechanical impurities or acids.

The viscosity has a direct influence on the thickness and the speed of formation of the oil film between the parts in friction and thus on their wear. The parts wear is inversely proportional with the viscosity of the oil used. The vegetal and mineral, the naphtenes or asphalt oils provide a thin and stable film. The chemical stability is the property of lubricants to preserve their characteristics on though conditions of functioning (temperature, pressure, chemical agents etc.).

2.3 The specific pressures

The pressure increase over the prescribed limits between the surfaces in contact produces the wear increase.

Experimentally, it was demonstrated that in conditions similar to the dry friction, the wear is approximately directly proportional to the pressure. In the conditions of the semi-liquid and liquid friction, the wear also increases, in the same time as the pressure increase, but not proportionally. The more the pressure is bigger, the more the oil film diminishes or it even breaks and so the wear increases.

2.4 The quality of the assembly

It is determined by the correct position of the parts within an assembly and of the precision of clearances or of its compression.

These ones also have a big influence on the resistance to use.

The position of a shaft in a bearing determines the contact surface between the neck and the bearing and, consequently, the working pressure the temperature and the lubrication. All these have a big influence on the wear degree of the friction surfaces. This is due to the fact that the functioning duration of an assembly is determined by its maximum admissible clearance.

The more the parts wear, the clearances between them increase, and so their functioning becomes irregular, there appear additional dynamic loads (shocks), accelerating the wear.

The shocks and the friction between the parts of the assembly cause the heating of the lubricant. An irregular heating of an assembly in friction means that there are shocks, so wears and big clearances. When they increase more, there are produced picks and the parts' break appears.

2.5 The operation conditions

They influence both the wear degree and the functioning duration of the vehicles. The functioning on highways not modernized, the passing of obstacles at high rates of travel, the use of fuels and lubricants of inferior quality, the frequent stops and the starts, the frequent changes of speed and the excessive use of the brakes influence significantly the good functioning of the vehicle and the wear of its parts.

The heat regime of the engine during the operation is very important. The optimum temperature of the engine is of 80 … 90°C. The higher temperatures during the summer or the lower ones during the winter lead to the intense wear of the parts of the piston – cylinder assembly.

3 THE IMPROVEMENT OF THE QUALITY OF THE PARTS' SURFACES, BY APPLYING HEAT TREATMENTS

The heat treatments represent nowadays the most frequent method to modify the characteristics of materials and alloys, due to which their fields of use increase. The heat treatments are inserted during the technological process of manufacture of the parts, the tools or other metallic products, and they can apply to the half-finished products in the various stages of execution, inserted between the operations of their mechanical treatment. The purpose to apply the heat treatments consists of the modification in the desired direction of the structure of the metal or that of the alloy. The modification of the structure and thus that of the properties, produced by a heat treatment, must be remanent. In order to modify the structure of an alloy, found in stable state, before the heat treatment, the constitutional diagram of the alloy must indicate some transformation in solid state when heating. If the alloy is found in an unbalanced state, by heating it is possible to approach the balanced state and that the properties modify. The metal alloys can also be heat treated by satiating their surface with other substances. All the types of heat treatments can be classified in five big groups and treated as follows.

a) 1st Group. The annealing of non-stage crystalline modification. This group contains the operations of heat treatment that apply to the metals and alloys which cannot bear transformations in solid state. The purpose to apply these operations is to bring in the state of thermodynamic balance a material found in an unbalanced state. The unbalanced state can be caused by the various previous mechanical treatments. This annealing are performed by heating the material over the crystalline modification temperature, maintaining it at this temperature and slowly cooling it afterwards. The treatment operations of this group can also apply in the case of the metals and the alloys for which on the constitutional diagram there appear transformations in solid state, but in this situation, the heating of the material is made at sub-critical temperatures.

b) 2nd Group. The annealing of stage crystalline modification. The heat treatment operations of this group apply to the metals and the alloys which suffer transformations in solid state and are intended to bring these materials from an unbalanced state to the balanced state. These operations consist of the alloy heating over the transformation temperature (the critical point), the maintenance at this temperature and the slow cooling. Due to the slow cooling, the alloys receive the balanced structure, because all the transformations of the constitutional diagram have time to develop. This annealing apply to the moulded bodies, to those heat distorted or cold distorted and to the welded ones. The operations of heat treatment of the first two groups apply to half-finished products or to the semi-finished parts, representing the so called primary heat treatment or preliminary heat treatment.

4 PRESENTATION OF THE MODERN METHOD TO ESTIMATE THE PRESENT POSSIBILITIES TO DIMINISH THE WEAR PHENOMENON

The method which shall be presented is based on the multi-criteria advanced analyse and it can be used with exceptional results, when choosing the most efficient methods, techniques and proceedings to diminish the wear phenomenon, to which there are submitted the parts and the subassemblies of the composition of the technical equipments of industry and transports. The method can be successfully applied to elaborate the various types of technical classifications, when choosing the optimum variant regarding the design of a technical creation or other ones, when comparatively estimate several variants of technical creations and it necessary, when selecting, based on the estimation, the best variant (the optimum variant), when putting in value order, based on some criteria, of several variants of the same performance and when comparing one or several own variants, with the existing variants of a technical product or other objects.

This type of analysis can be used very well to obtain several technical classifications, or of other fields of activity, in which the subjectivism is largely removed. There can also be scientifically established which technical variant is the best to use, when in that field there are more than just one variant to be used. If there were found several solutions, there must be made a comparative analysis between them, the own solutions found, or there must be comparatively analyzed the one solution or the own solutions found, as compared to the similar existing solutions.

It is very important the fact that this analysis must depend on the criteria chosen, an analysis which gives in a very big proportion an objective character to its results, for the following reasons:

- the criteria order is established by comparing each two criteria one to the other;
- it must be considered, by a simple mathematical expression, the fact that the relative position of two criteria can meet just three situations: one criterion is more important than the other one, one criterion is as important as the other one and one criterion is less important than the other one;

- when comparatively analysing the various variants, the analysis is made separately, from the point of view of each criterion.

The strict analysis consists of the following stages:

- to establish the criteria;
- to determine the value of each criterion;
- to identify all the variants;
- to grant a grade N;
- to calculate the products between the grades N and the value coefficients;
- to chose the best variant and to draw the conclusions.

The method shall be concretely applied in the following paper, for a technical case.

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BEHAVIOR OF HORIZONTAL AND VERTICAL FOLDED PLATE ELEMENTS IN SHIP STRUCTURE

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Abstract: *Usual, the folded plate elements of folded longitudinal bulkheads of tankers are vertical orientated. The construction with horizontal folded plates is not restricted by Rules of Ship Construction, but this variant are seldom used, although offers some technological and exploitation advantage. The behavior of vertical folded plate elements in contrast with horizontal folded plate elements in axial tension/compression states, needed for evaluating of ship limit bending moments, is presented in this paper.*

Keywords: *ship, plate, structure.*

1 INTRODUCTION

Frequently, the longitudinal bulkheads of tankers are made of vertical folded plates (fig. 1). Structural variant with horizontal folded plates (fig. 2) may be a progress, as offers some technological and exploitation advantage [7] Moreover, this it may be extended to double side of tankers (fig. 3) and bulk-carriers, which lead to considerable ship's hull weight decreasing.

To assess the ship's hull general bending strength, the limit moment concept may be used following some initial premises. There are several limit moments.

Assuming that there are no buckling plates due to compression, the moment corresponding to the first yield occurring (the stresses are entirely elastic in all remaining cross-section area) is named *Initial Yielding Bending Moment*, $M_Y = \sigma_Y W_D$, where $\sigma_Y = R_{eH}$ is the material's yielding stress and W_D the section modulus at deck's level.

If in all cross-section's points the stress equals the yield stress, then the corresponding limit moment is named *Fully Yielding Bending Moment*, $M_P = \sigma_Y W_{pl}$, where W_{pl} (plastic strength modulus) is the sum of the static moments in respect with the y_p axis and computed using the cross-section's areas above and below this axis - axis which halves the cross-section. In achieving the plastic limit bending moment, the Prandtl material constitutive law is assumed (also Classification Societies Rules recommended).

The M_P moment was initially proposed by Caldwell (some corrections added) as a ship's transverse section general bending verifying criteria [8]

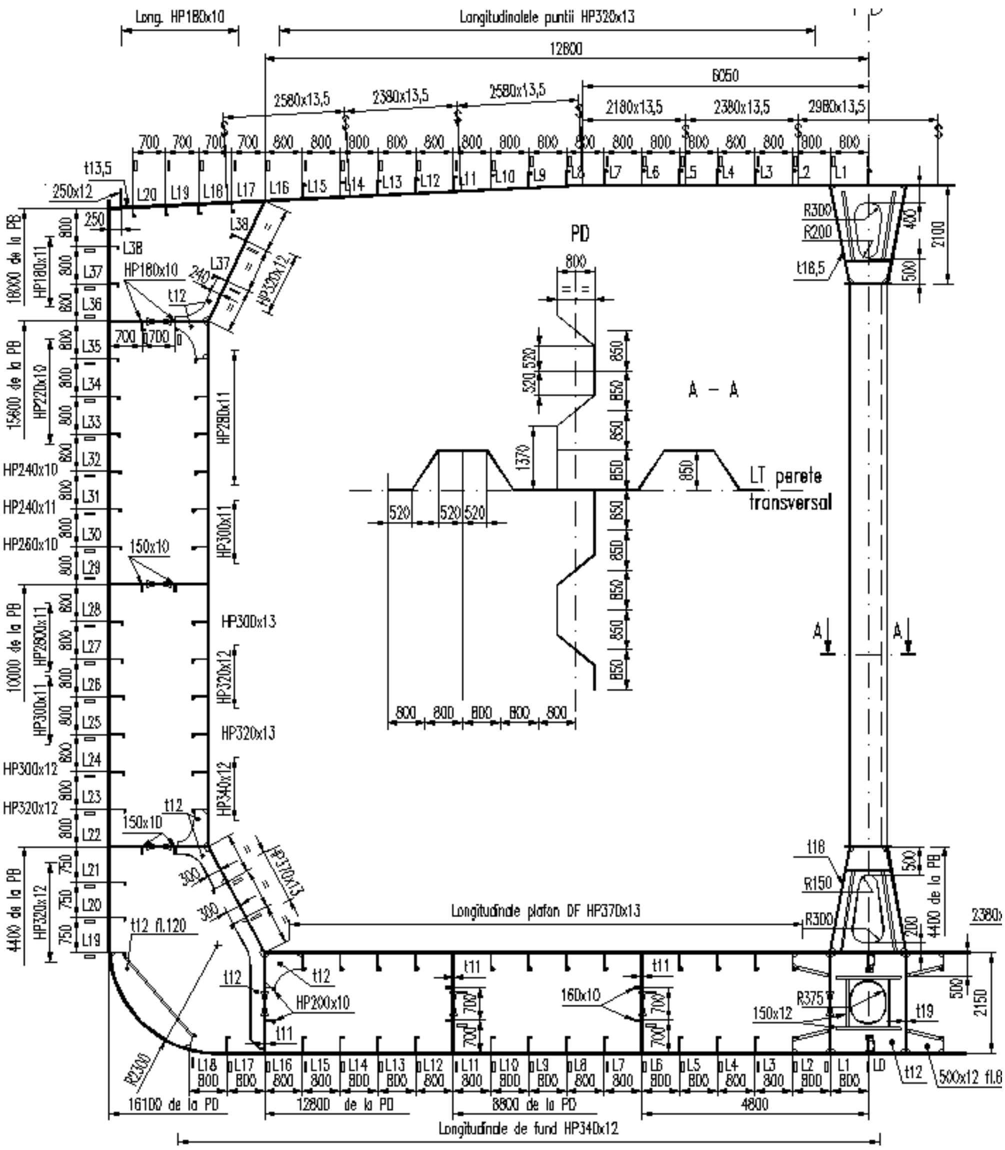


Fig. 1

The *Ultimate Bending Moment* of a hull girder transverse section in hogging and sagging conditions (M_{UH} and M_{US}) are defined as the maximum values of the curve of bending moment capacity M versus the curvature χ of the transverse section. In this concept, first introduced by Smith [12] until the general collapse state is achieved, the various ship's section parts are successively attaining limit states such as buckling/plastic deformations, subsequently the approach being named as ship's section's progressive collapse.

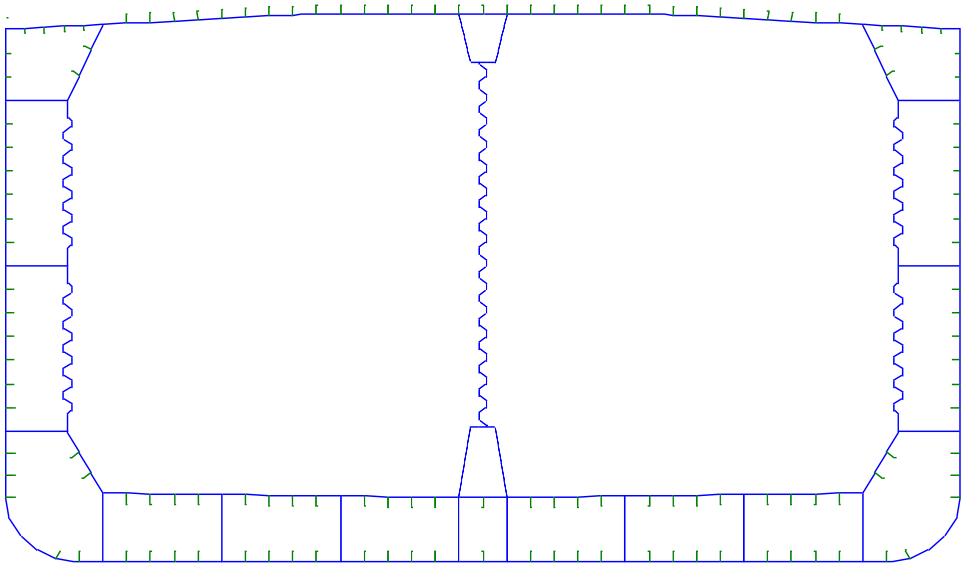


Fig. 2

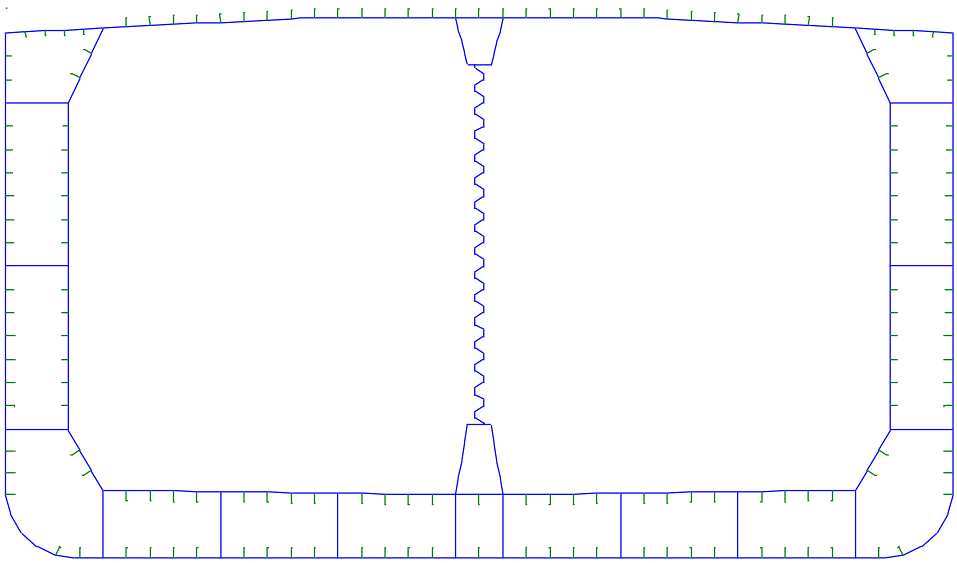


Fig. 3

2 AVERAGE STRESS - AVERAGE STRAIN DIAGRAM FOR HORIZONTAL FOLDED PLATES

In all codes for limit bending moment calculation and progressive collapse evaluating, based on Smith approach algorithm, the cross section is automatically divided into elements, for which must be a priori to model the tensile and the compressive behavior. For isolated folded plates, the average stress - average strain diagrams (σ_m - ε_m) is also need. This diagram is similar with (F - ε_m) diagram, where F is the applied force.

In order to obtain the F-ε_m diagram for vertical folded plates a unit strip is considered as shown in figure 4. For this strip, which is a beam with polygonal path, can be determined the displacement in direction of applied tensile force F, using Castigliano's theorem,

$$\Delta l = \frac{\partial U}{\partial F} = \frac{\partial}{\partial F}\left[\sum_i \frac{1}{2}\int_{l_i}\left(\frac{N^2 \mathrm{d}x}{EA} + \frac{M^2 \mathrm{d}x}{EI}\right)_i\right] = \sum_i \int_{l_i}\left(\frac{N}{EA}\frac{\partial N}{\partial F}\mathrm{d}x + \frac{M}{EI}\frac{\partial M}{\partial F}\mathrm{d}x\right)_i \quad . \qquad (1)$$

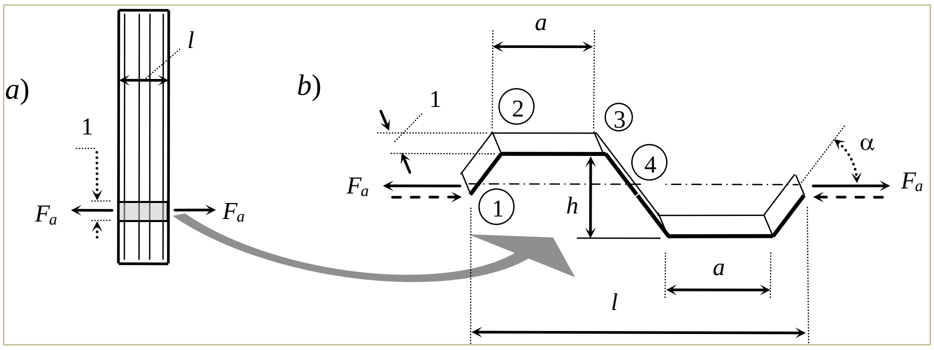


Fig. 4

For 1-2, 2-3 and 4-3 zones (fig. 4):

$$l_{12} = h/(2\sin\alpha) = (l-2a)(\tan\alpha)/2 \quad , \quad l_{23} = a \; ,$$
$$l_{43} = h/(2\sin\alpha) = (l-2a)(\tan\alpha)/2 \; ;$$
$$N_{12} = F_a \cos\alpha \quad , \quad N_{23} = F_a \; , \quad N_{43} = F_a \cos\alpha \; ,$$
$$M_{12} = F_a x \;\; \sin\alpha \quad , \quad M_{23} = F_a h/2 \quad , \quad M_{43} = F_a h/2 \; .$$

Substituting these expressions in (1), it results:

$$\Delta l = F_a\left[\frac{2a+(l-2a)\cos\alpha}{EA} + \frac{h^2\left(6a+\dfrac{l-2a}{\cos\alpha}\right)}{12EI}\right] =$$

$$= F_a\left[\frac{2a+(l-2a)\cos\alpha}{Et} + \frac{h^2\left(6a+\dfrac{l-2a}{\cos\alpha}\right)}{Et^3}\right] ,$$

and:

$$F_a = \frac{Et}{[2a+(l-2a)\cos\alpha]/l + \{h^2[6a+(l-2a)/\cos\alpha]\}/(t^2 l)}\frac{\Delta l}{l} \quad . \qquad (2)$$

Taking into account that:

$$\varepsilon_a = \Delta l/l \quad , \quad A = 1.\,t \quad \text{and} \quad I = 1.\,t^3/12 \,,$$

where t is the plate thickness, it results:

$$F_a = t \;\langle mm\rangle\; E_{vf}\langle N/mm^2\rangle\; \varepsilon_a \;\; \langle N/mm\rangle \,, \tag{3}$$

in which:

$$E_{vf} = k_r E \quad , \tag{4}$$

and:

$$k_r = \frac{l}{2a + (l-2a)\cos\alpha + h^2[6a + (l-2a)/\cos\alpha]/t^2} E \quad . \tag{5}$$

Can be observed that $E_{vf} < E$ and it trends to E if α and implicit h trends to zero. The very low value of E_{vf} in comparison with E shows that vertical disposed folded plates have practically an insignificant contribution in vertical bending of ship. Coarse quantitative estimations of this contribution can be obtained by considering the usual limit strains $\varepsilon_{a\,\max}$ for which appear ultimate bending moments, in hogging and sagging. This value can be obtained based upon ultimate curvature – which depends on the ship's size. For medium ship's size, the curvature and derived from this maximum average strain has the size order:

$$\chi \approx 10^{-6}\, mm^{-1} \quad , \quad \varepsilon_{a\,\max} \approx 10^{-2} \,, \tag{6}$$

which are much smaller comparing to those that corresponds yielding. In fact, considering the force eccentricity in respect with 2-3 plate, it results:

$$\sigma = \frac{F_a}{t} + \frac{F_a h}{2}\frac{6}{t^2} = \frac{F_a}{t}\left(1 + 3\frac{h}{t}\right) \quad , \tag{7}$$

and the yield appear ($\sigma = \sigma_y$) for the force:

$$F_{ay\,vfp} = \sigma_y t \frac{1}{1 + 3h/t} \quad , \tag{8}$$

for which is obtained the strain:

$$\varepsilon_{ay} = \frac{F_{ay\,vfp}}{tE_{vf}} = \frac{\sigma_y}{E}\frac{t}{3h+t}\left(\frac{2a + (l-2a)\cos\alpha}{l} + \frac{h^2}{t^2}\frac{6a + (l-2a)/\cos\alpha}{l}\right) \quad . \tag{9}$$

Diagram F_a - ε_a from figure 5, *a* shows that:

$$F_{a\,\max} = t\,E_{vf}\;\;\varepsilon_{a\,\max} << F_{ay\,vfp} \;\;, \tag{10}$$

i.e. vertical disposed folded plates in tension always remain in elastic range and has insignificant contribution on ship bending.

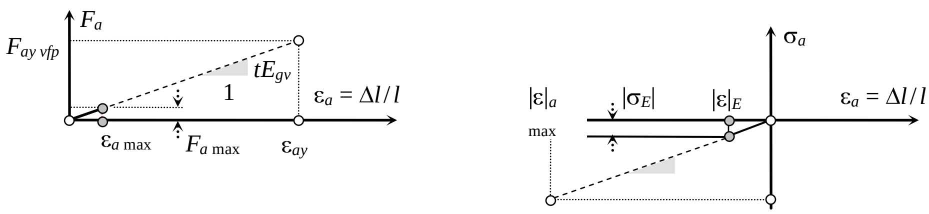


Fig. 5

In compression, $\varepsilon_{a\,\max}$ always exceeds the Euler plate strain level (fig. 5, *b*),

$$|\varepsilon|_E = \frac{\pi^2}{12\,(1-\upsilon^2)}\left(\frac{t}{a}\right)^2 \;\;, \tag{11}$$

and therefore $|\sigma_{a\,\max}| \le |\sigma_E|$. Limiting $\sigma_{a\,\max}$ value to σ_E value, it results:

$$|F_{a\,\max\,compr}| = t\,E_{vf}\,\varepsilon_E << |F_{a\,\max}|\,, \tag{12}$$

where $|F_{a\,\max}| = t\;E_{vf}\,|\,\varepsilon_{a\,\max}|$. Therefore, vertical disposed folded plates in compression have also insignificant contribution on ship bending.

***Example*.**

For $\sigma_c = 355$ *MPa*, $E = 208.000$ *MPa*, $a = 1{,}040$ *m*, $\alpha = 50^{\circ}$, $l = 3{,}20$ *m*, $t = 12$ *mm*, $h = (l/2 - a)\tan\alpha = 786$ *mm* ($A = 11.323$ mm^2), results:

$$k_r = 0{,}7.10^{-4} \;\;,\;\; E_{vf} = 14{,}4 MPa$$

$$\varepsilon_{ay} = \frac{\sigma_y}{E_{fv}}\,\frac{1}{3h/t+1} = 1{,}25\times10^{-1} \;\;,\;\; F_{ay\,vfp} = t\,E_{vf}\,\varepsilon_{ay} = 21{,}6\;MN/mm$$

$$\varepsilon_{a\,\max} \approx 10^{-2}\,,\;\; F_{a\max} = t\,E_{vf}\,\varepsilon_{a\max} = 1{,}73\;MN/mm$$

$$|\varepsilon_E| = 1{,}2\times10^{-4} \;\;,\;\; |F_{a\max\,compr}| = t\,E_{vf}\,\varepsilon_E = 0{,}02\;MN/mm$$

3 AVERAGE STRESS - AVERAGE STRAIN DIAGRAM FOR HORIZONTAL FOLDED PLATES

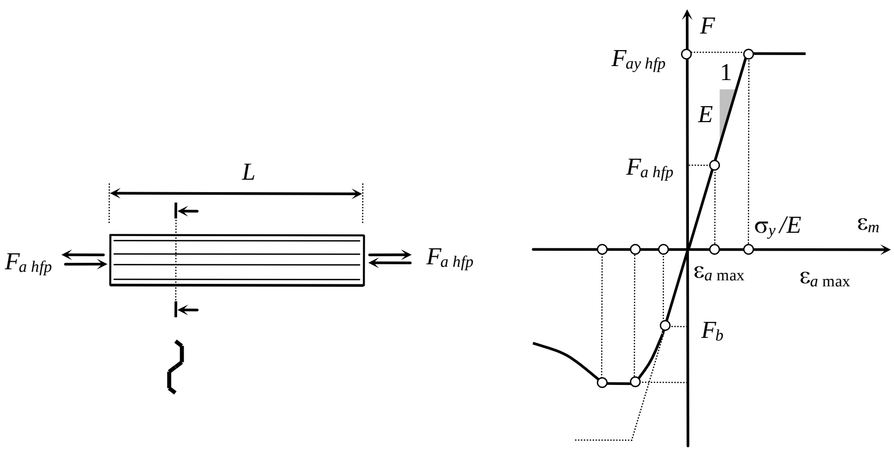
For horizontal folded plates (fig. 6, *a*) in tension, the force-strain relation in elastic range is:

$$F_{a\,hfp} = EA\varepsilon_a \,, \tag{13}$$

where E is the Youngh modulus, A is the entire transversal area of folded plate and ε_a his average strain.

With Prandtl model, the *tension* force of horizontal folded plates for strain beyond yield strain $\varepsilon_y = \sigma_y / E = 1{,}46.10^{-3}$ (σ_y - yield stress) has the constant value:

$$F_{ay\,hfp} = A\sigma_y \,. \tag{14}$$



a) *b*)

Fig. 6

Relation (13) remains valid also for horizontal folded plates in *compression*, up to the value of force equal to min $[F_{ay\,hfp}, F_b]$ where F_b is the folded plate buckling force. This can happen usually in elasto-plastic range. The obtaining of analytic expression for this force is a complicated issue; therefore it has to be determined by numerical procedure. Anyway, the $F_{ay\,hfp}$ and F_b forces are much bigger as $F_{ay\,vfp}$ respectively $F_{ay\,hfp}$. In absence of transversal forces and initial deformations, the buckling occurs beyond yield and so an approximate estimation of ultimate strengths can be made on the basis of $F_{ay\,hfp}$.

4 CONCLUSIONS

– Rigidity of vertical folded plates can be considered the same in tension and compression, for all ranges of ship bending (beyond and over limit states). This rigidity is insignificant in comparison with case of horizontal folded plates.

– For horizontal folded plates can be considered the behavior at tension and compression same as hard corners elements, that is the Prandtl model.

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SOME PRACTICAL ASPECTS CONCERNING THE ACHIEVEMENT OF THE INDICATED DIAGRAM OF A S.I. ENGINE

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Abstract: *The experimental researches of a SI thermal engine it governed by the rules based on many standards. Obviously, for the best results, it is very important the technical endowment of the workroom including the engine test bench. Based on the large experience in the engine researches of the Automotive Department of the Mechanical Engineering Faculty Brasov, the paper presents the testing methodology, that means, from engine mounting on the test bench to the correct matching and adoption of a various transducers, from the conditioning amplifiers to the computer-compatible data acquisition, purposing the achievement of the indicated diagram.*

Keywords: *Engine, diagram, S.I.*

1 INTRODUCTION

To increase the SI engine efficiency is necessary to study the engine burning by measuring various quantities, particularly the burning room pressure. To do this, the cylinder head must tooled, however for the engines with more than too valves per cylinder, it is almost impossible. A low cost measurement spark plug can be use for a SI engine indicate pressure achievement. It presents the results of this kind of measurement on two different SI engines, one with tree different compression ratio.

2 THE EMPLACEMENT OF THE ENGINE ON THE TEST BENCH

The unit engine – brake must be isolate from the labor building basement, via an elastic coupling, by using an additional inertial lest to reduce the induced vibration effects. The labor must be according with the regular environment laws. The Brasov environmental conditions, at 652 m altitude, were as follows:

- Atmospheric pressure P_{atm} = 0.95 bar (712.5 torr);
- Ambient temperature T = 20ºC.

2.1 The goal of an basically engine research

For a complete burning process research, it is assuming the follows:

- the maximum engine load characteristics;
- the partial engine load characteristics;
- the consumption characteristics;
- the polluting emissions;
- the knock burning test;
- the ignition timings.

An existing arrangements for an Otto engine test bench show in (Fig. 2.1), where the engine external characteristics must limited by behavior in service of the brake's operational range, as shows in (Fig.2.2)

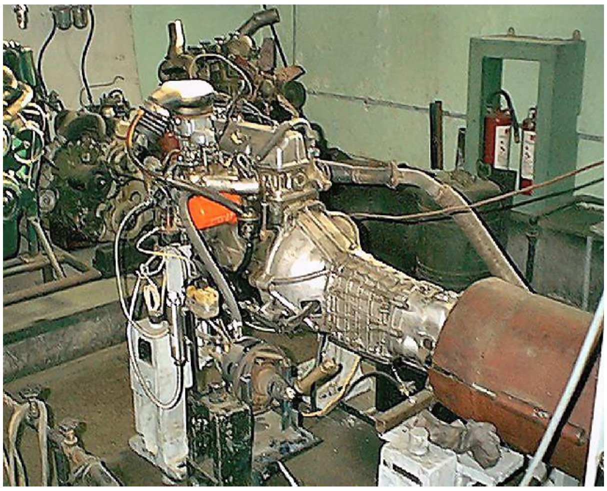


Fig. 2.1 The engine test bench

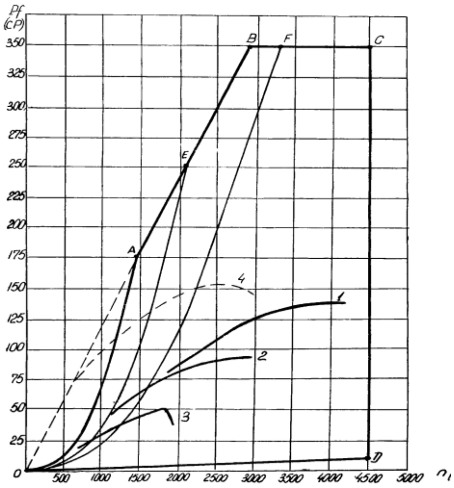


Fig.2.2 The hydraulic brake characteristics

3 THE METHODOLOGY OF EXPERIMENTAL RESEARCHES

The experimental researches claim a planning of a general proofing program, once the test bench is ready, involving the following steps:

- The main objectives assignation;
- The main resurces getting (fuel, lubricants, measurement devices, electrical equipement, wiring etc.);
- DAQ and measured amount of the different value computer-compatible data acquisition.

3.1 The achievement of the measured quantity

Purposing to remove the measurement method errors, also by didactical reasons, each parameter will measured by different way, each included in a typical measuring chain shown in figure.3.1.

- *The engine speed*, using the folow sensors:
  - variable reluctance (inductive);

- variable capacitance;
- *Hall* type.

- *The engine torque,* using:
  - the cradle dynamometer;
  - the RF tensometric torque sensor.
- *TDC and crank angle degree* sensor.
- *The different themperatures* (inlet air, oil, exhaust gases), by:
  - thermocouple *NiCrNi*;
  - thermoresistance *Pt100*;
  - thermal gauge:
  - mercury thermometer;
  - thermistor (*PTC* or *NTC*);
  - semiconductore devices.
- *The various pressures* (atmosferic, inlet air/exhaust gases pressure, burning room, fuel injection equipement), by:
  - piezoelectrically sensors;
  - piezoresistive sensors.
- *The engine block vibrations*, using the TEDS accelerometers.
- *The angular / linear displacement*, using the resistive or inductive sensors.
- *The pollution emissions*, using:
  - Smokemeter Bosch type;
  - Smokemeter Hartrige type;
  - Gase analyser (CO,CO_2, NO_x, HC);
  - Sound level analyser.
- *The inlet air flow*, using a differential pressure sensor.

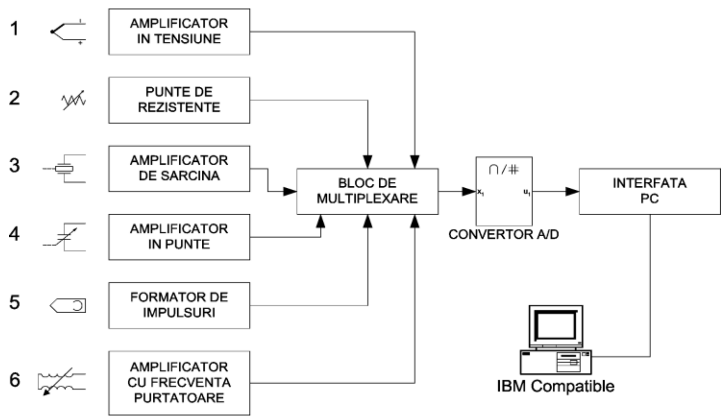


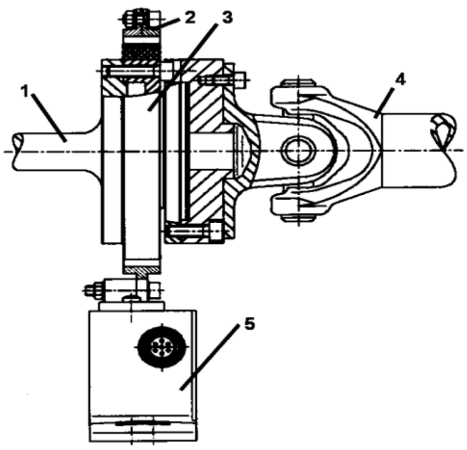
Fig.3.1 A typical DAQ system.

4 THE SENSORS SETTING

Each sensor will be fit in place according to the manufacturer prescriptions, e.g. the alignment of the rotating pieces, the align reaming of a piezoelectric sensor, various sealing mode, cleaning the electrical connections, etc.

4.1 The torque sensor's placement

The main sensor in the engine researches is the torque sensor, in this case, a tensometric contact less Radio Frequency (RF) controlled, shown in figure.4.2.

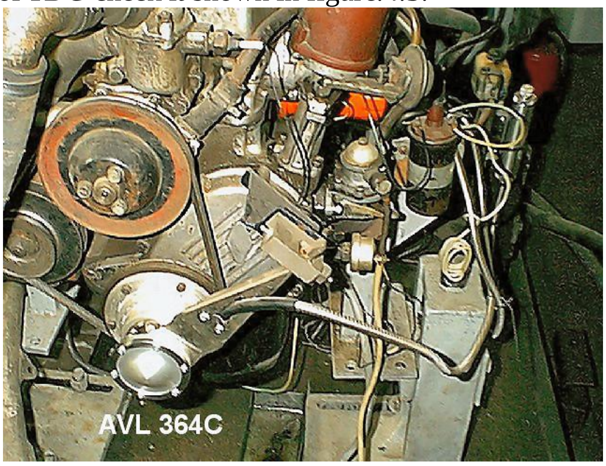


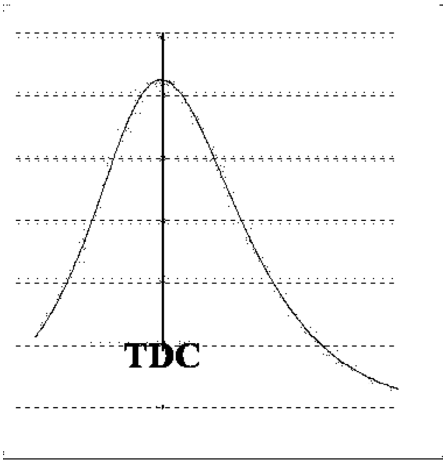
a **b**

*Fig.4.2. (**a**) The torque sensor placement. 1–hydraulic brake; 2–antenna; 3–the contact less torque sensor body. (**b**) The torque sensor assembly. 1–the brake shaft; 2–the antenna; 3–the sensitive body; 4–the engine shaft; 5–the electronic conditioning device.*

4.2 The *TDC* and *CDM* encoder placement

The positioning of the *TDC*, setting with 0.1 ˚CA precision, must be make both by static and dynamic methods; means setting the piston *TDC*, by measuring the piston displacement, then checking the *TDC* marker by running the engine, if it possible by suppressing the ignition in the considered cylinder. The encoder placement and the results of *TDC* check it shown in figure.4.3.





a **b**

*Fig. 4.3. **a** The crank angle encoder placement. **b** Checking the properly TDC marker adjustment.*

4.3 The measurement spark plug

A connection pipe between the burning room and the piezoelectric sensor, characterizes the measurement spark plug shown in figure 4.4, where is presented a schematic draw and a practical realization; note the values of length L = 42 mm and, d = 0.8 mm diameter.

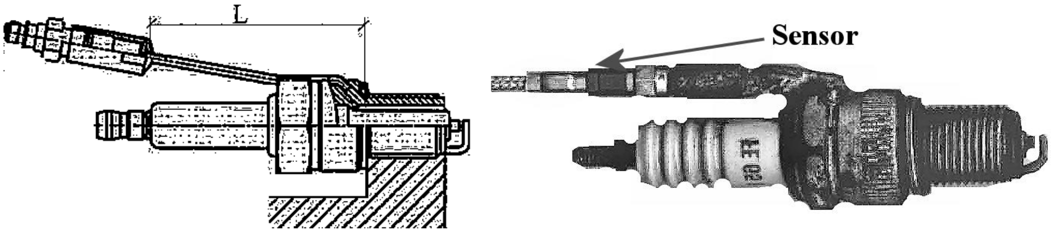


Fig. 4.4. The measuring spark plug included a piezoelectric sensor.

4.4 The piezoelectric sensor and the spark plug sensor fitting

It has been used a piezoelectric sensor specially build purposing the spark plug upgraded. with the sensitivity of 18.82 pC / bar, up to 250 ˚C, temperature compensation. The sensor's sheet data and the placement of the measuring spark plug on the cylinder head is shown in figure 4.5. The specially double shielded sensor’s cable provide a protection against the induce electromagnetic field by the spark plug high voltage supply cable.

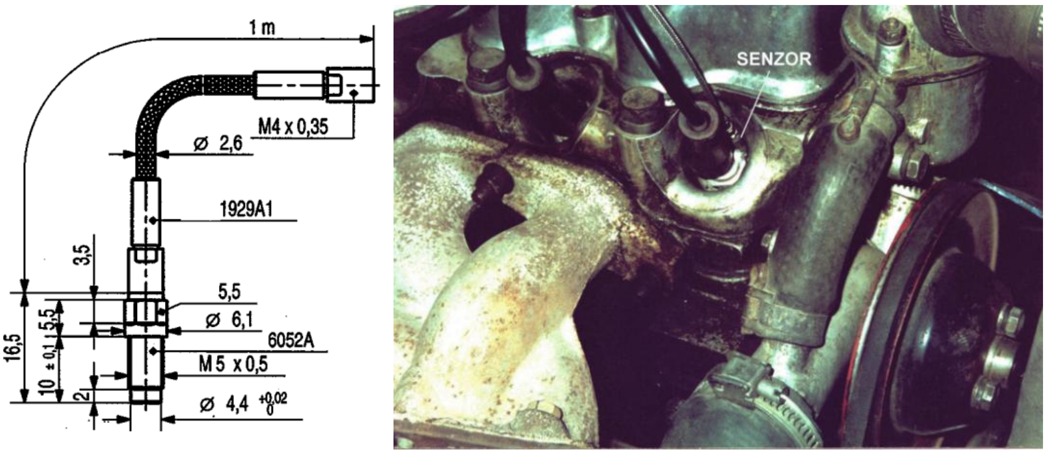


Fig.4.5. The piezoelectric pressure sensor and their placement on the engine.

5 THE RESULTS OF TESTS

There have been tested two SI engine, purposing to evaluate the measurement spark plug performances on a typical measurement installation, purposing the indicated pressure.

Both the engines were very similar, regarding the carburetor fuel supply, the spark ignition systems and same power, about 50 kW etc. However, one of the engine, were with variable compression ratio, by different technical solutions, e.g. by change the cylinder head and gasket bonded seal, with compression ratio ε = 8.5, 11, 12.5.

5.1 The burning cyclic dispersion

First, it was been performed the successive burning cycles, to find the cycle dispersion, very similarly for both engines, showing in figure 5.1.

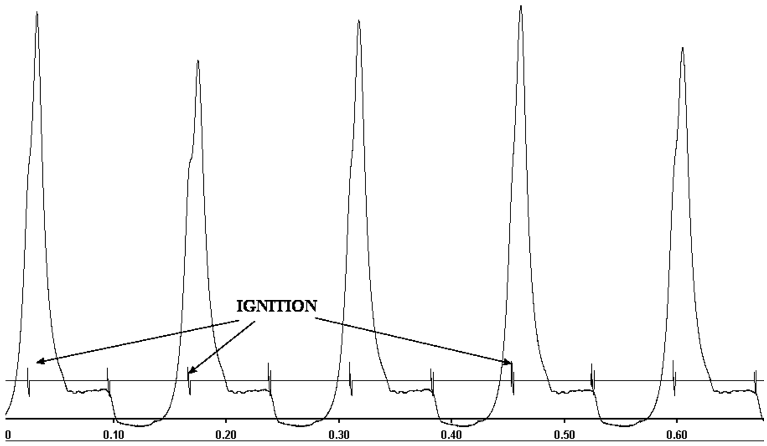


Fig.5.1. The burning cyclic dispersion.

5.2 The indicated diagram

For the engine, an ε = 8.5 compression ratio, the engine pressure evolution it shown in figure 5.2, and for an engine with different compression ratio, the indicated pressure it shown in figure 5.3.

It can see that in figure 5.2, the moment of ignition induce a rise of the indicated cylinder pressure; it can suppose the ignition high voltage induces an electromagnetic field into the piezoelectric cable, which can affect the measured electrical charge of the sensor; the unexpected rise of pressure shows like the spark ignition voltage evolution.

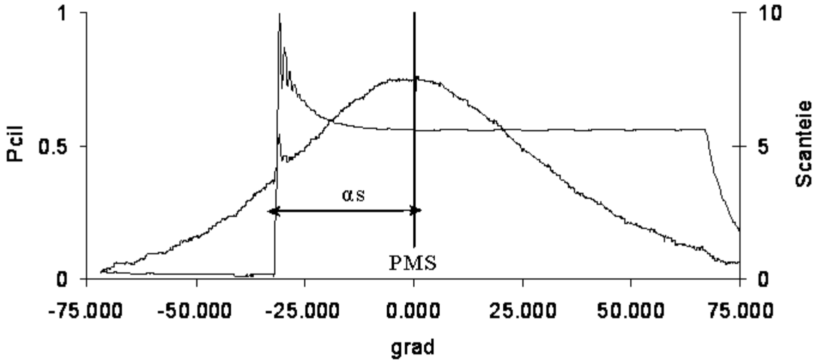


Fig. 5.2. The measured burning room pressure.

However, by increasing the hydraulic brake torque, this pressure rises again, but without following the spark ignition’s voltage.

For elucidation, the engine has tested by three different compression ratios, the results is presented in figure 5.3, where the rise of the burn pressure does not appear.

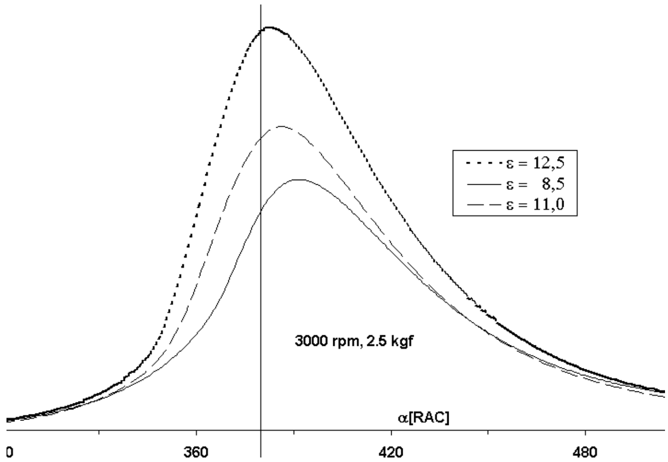


Fig.5.3. The indicate pressure for different compression ratio.

5.3 The knock burning

It is the time to consider the abnormally knocking burning processes. Rising the engine load, it can observe a rising of the indicated pressure, conjunctly with the rise of the engine block vibration shown in figure 5.4.

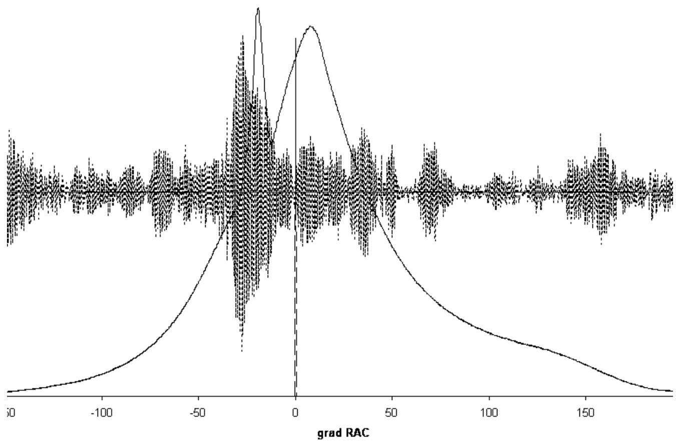


Fig.5.4. The engine block vibration shows the rise of burning room pressure.

6 CONCLUSION

- The measurement spark plug has been calibrated and is appropriate for burning room pressure measurement;
- The measurement test devices it properly for an accuracted indicate diagram achievement;

- The local pressure rise, accompanying of a rise of engine block vibrations, detected by an accelerometer;
- The local pressure rise is due to local ionization near the spark plug gap, probable due to special burning room architecture, but not to the connection pipe to the piezoelectric sensor;
- No pressure rise has been observed in case of variable compression ratio engine, even though the compression ratio was strongly modified, so in conclusion, the connection pipe doesn't disturb the burning pressure phenomenon.

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A SWOT ANALYSIS OF BIODIESEL FUEL TECHNOLOGY IN ROMANIA

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Abstract: *Protecting the environment is essential for the quality of life of current and future generations as well as for economic growth. Given that the Earth's natural resources and the man-made environment are under pressure from growing population, urbanisation, continuous expansion of the agriculture, transport and energy sectors, as well as climate variability and warming at local, regional and global scales, the challenge facing the Romania is to ensure continuous and sustainable growth while at the same time reducing negative environmental impacts. The aim of this paper is to analyze the economic challenge, economic costs and agricultural impact in Romania into increasing biofuel using conditions.*

Keywords: *SWOT, biodisel, fuel, environment.*

1 INTRODUCTION

The increased interest in biofuels can be explained by a range of factors, including ecological, economic and geo-political reasons. The rapid growth in energy consumption and, more specifically, in fossil fuel use in the transportation sector, has lead to commensurate growth in emissions that are harmful to the environment at local, regional and global levels. High crude oil prices and the finite supply of fossil fuels create additional economic incentives for using alternative fuel sources, and encourage research in this area. Rising oil demand has lead to a growing dependency on a relatively small number of oil supply regions which, in some cases, are considered a geopolitical risk. In addition, farm organisations and other farming groups continue to be on the look out for new markets for agricultural products as a way to generate higher incomes for their producers

.

Because renewable fuels are generally still more expensive to produce than fossil-based fuels, their commercial viability often depends on policy interventions by governments, although in the future this will depend on the further development of crude oil prices. In many instances, biofuel production has been promoted by government programmes, either through the provision of market incentives or by market regulations. In terms of market incentives, tax concessions are typically given through lower or zero excise taxes relative to those applying to traditional fuels, but can be provided through direct tax subsidies, too.

Vehicle taxes and subsidies can promote sales of cars running on biofuels, while public investment subsidies, such as for research and development etc. can increase biofuel supplies. Regulatory measures include fuel blending standards and bans on certain chemical ingredients in fuels which can alter the transport fuel mix.

From it's validation in 1997, the Kyoto Protocol upon United Nations Frame Program about climatic changes (1992), renewable energy sources industry has been pushed toward capitalisation on global market, a goal that can be achieved concentrating all the efforts to reduce the greenhouse gases. This Protocol stipulates that advanced countries must reduce the emissions of greenhouse gases up to 5.2% compared with 1990 level.

The most important legal document in renewable energy field is The Directive 2001/77/EC regarding the promoting of new and renewable energy sources. This Directive stipulates that until 2010, 12% from the total amount of energy must be produced from renewable sources. The contribution of renewable sources (solar energy, biomass, biogas, bio-fuel, wind energy) must be increased from 14% to 22%.

Since 2000 the EU Commission has proposed a considerable number of new legal instruments to promote renewable energy and energy efficiency. The European Parliament and Council have adopted the followings which are in implementation in the member and also in the accession countries, like Romania:

- Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources (OJ L283/33, 27.10.2001);
- Directive 2003/30/EC on the promotion of biofuels (OJ L123/42, 17.5.2003).

2 ROMANIA BIOFUELS POTENTIALS

Biodiesel is a biofuel that has much the same characteristics as normal diesel oil, but as opposed to diesel it is not derived from petroleum but from vegetable oils or animal fat. Generally, vegetable oils are used such as sunflower oil, soy oil, rape oil or palm oil. Used oils may be used likewise very well indeed. To produce biodiesel from these oils, they are subjected to a chemical reaction, which is called transesterification. It is a chemical reaction that makes the glycerol present in the oil to be substituted by methanol. Its result is a methyl ester. One of its examples is rape methyl ester (RME). A residue forms due to transesterification, called glycerine. Biodiesel's plus-points are obvious: It is biodegradable, it decreases soot-emission with ± 50%, it decreases emission of hydrocarbons and it is CO_2-neutral.

In several European countries, including Austria, Italy, Spain, Frace and Germany biodiesel is seriously applied, with France and Germany as absolute leaders. Over 150,000 cars run on biodiesel in Germany, for instance, and scattered over the country there are well over 1,200 service stations with a biodiesel pump. The reason of the biodiesel success in Germany is the fact that no excise is levied on biodiesel, which makes its price an average of 4-8 cents below that of normal diesel.

Obtained naturally from agricultural products, environmentally friendly, biofuels are seen as a viable alternative to traditional combustibles. The European EC/2003/30 directive dating May 2003 says the minimum percentage of biofuel (bioetanol and biodiesel) that must be brought on the market by each member state should be 2% by December 31, 2005, and 5.75% by the end of 2010.

Romania adopted the European directive in 2005, setting an objective to reach the 2% level by January 1, 2007 and the 5.75% threshold by 2010. But as the directive is not compulsory, it does not contain coercive measures.

Romania has assumed to adopt the community legislation in energy sector, including the renewable energy sources sector, even that it hasn't been realised a notable progress regarding the promotion of renewable resources.

Biofuels technologies were considered within several R&D projects. Research centers as INMA-the National R&D Institute for Machinery in Agriculture and Food Industry, ICECHIM Chemical Research Institute, ZECASIN, developed studies and pilot installations regarding biofuel production. The harmonisation and connection with the FP European programmes is a permanent goal.

Today in Romania, practically there is no production for biofuel purposes, except a rather modest quantity of exported rape. However, the potential for a future biofuel raw material production is high, and may come from different approaches, regarding land and production availability.

The information presented above [1] regarding production of different agricultural raw materials as oil, sugar and starch crops, already existing on the market for other purposes than biofuel production, are relevant as it shows the efficiency, capability and experience to manage this kind of crops. This information constitutes the starting point for further consideration on biofuel raw material production. The land area used for these crops has in general a constant or slightly diminishing trend. Some production limitations are needed to ensure in future that the European common market functions properly. These limitations may be expected following the agriculture chapter accession negotiations. Nevertheless, the limitations in agricultural crop production will not be significant, and will be not a major source for production or land availability for biofuel purposes.

1. Sugar beet production. The only significant decrease is shown by the sugar beet production, following a more profitable raw sugar import from Brazil and Cuba (420,000 tones raw sugar import). It results that the difference between the today sugar beet production and the traditional sugar beet production, registered 7-10 years ago, may be immediately reactivated as raw material for biofuel production. This difference amounts to some 90 thou ha, or 1,800 thou tones, under current production efficiency.
2. Rape production. The large majority (90%) of rape production is exported, while the remaining rape and rape oil production is used in Romania for other purposes than biofuel (textiles and chemistry). USDA FAS informs that Romania exported 85,000 tones rape in EU (Germany, Denmark and Sweden) in 2001/2002. It is not known the use of the exported rape in EU, but most probably it is processed for biofuel production. The rape cultivated area and production have a continuous increasing trend. Currently, we may consider that over 100,000 tones of rape production are exported for biofuels production purposes.

3. Sweet sorghum production. For the moment the sorghum crops have a very modest volume and are used only as a cereal to obtain grains for animal food. The Chiminform research center, specialized in chemical processing engineering, developed recently a study stating the advantages of a future sweet sorghum production for biofuel production. The sweet sorghum production is not demanding as meteorological and soil conditions, while the specific ethanol production is equivalent as for the sugar beet culture, - around 6,000 liters/ha. From the plant, one obtains 3-8 tones sugar/ha, with a processing cost 40% lower than for sugar beet. The present production is up to 1 tone/ha for grains, and up to 50 tones/ha for the whole plant.

One of the most important sources for land and production availability will come from the increase in the production efficiency. Today, approximate 10.3 millions ha agricultural land are owned by 4,170 individual households, which fragments the ownership on land. Currently, cereals use nearly 37% of the utilized agricultural area of 14.8 million ha. The area used for maize is largest with 56% of cereals area in 2000, followed by wheat with a share of 35.5% . [1]

The next most important crop by area utilized is sunflower, with an area of about 900,000 ha . Arable production intensity is likely to go up, leading to higher yields per hectare and increased use of fertilizers and pesticides. The productivity increase may be about 3% per year. This trend is the response to a more stable agro-economic environment, and the gradual introduction of modern technology and machinery. The efficiency of production is much lower than in the EU countries. As example, for cereal yields the EU-15 reference is 4.77 t/ha, while in Romania the average is 3 t/ha. Regarding the oil, sugar and starch crops, the efficiency in

Romania is even 50 % lower than in EU countries (see table below). Considering that the production level is kept at the 2005 level, the improvement of productivity means that less land is needed for the same production and an important land area will become available, including for biofuel production purposes.

A general estimation made by the Research Institute for Soil Science and Agrochemistry [1] shows that from the total agricultural land resources - 14.8 mill. ha, ca. 3.7 mill. ha are arable land of good and very good quality. If intensively cropped, this area could be the basis (ca 0.17 ha per capita) for ensuring the food security of the country population and to allow conversion of the remaining area of arable land (ca. 5.6 mill. ha) to other uses. These other uses may be mainly grassland or forestland (those strongly degraded, one estimates that at least 1.5 mill. ha of agricultural land have to be afforested/reafforested), but biofuel raw resources crops may be considered here as well. Following the above estimation we consider that, following the increase of production efficiency, up to 1,000 ha may become available for other purposes (including biofuel raw material production) by 2010.

It is estimated that the amount of uncropped arable lands varies from year to year between 5 and 10 percent of the total farmland. It includes not only degraded or marginal lands, but also important areas of high quality lands whose holders do not crop due to different reasons: aged persons, decapitalization, especially lack of agricultural equipment for tillage or for other agricultural works, or simply because of the low income that can be obtained by agricultural activities. Through land restitution, an important share of the agricultural land (between 30% and 40%) according to different estimates was allocated to the owners that do not activate in agriculture (city dwellers and rural pensioners), who are not interested to cultivate directly the land.

Summing the above consideration on land and production availability for biofuels raw materials purposes, it may be considered that currently the existing potential is:
• 90 thou ha formerly used for sugar beet production;
• 85 thou ha rape area;
• 1,000 thou ha available arable land, presently un-cropped;
• 1,000 thou tones agricultural and forestry residues.

There is a high reserve for this potential to increase in the near future, as the available land resulting from higher production intensity may reach another 1,000 thou ha by 2010. The total figure of about 2,200 thou ha available land around 2010 for non-food crops is confirmed also by subtracting the arable land area agreed within the Agriculture chapter, - 7,013 ha, from the total arable land – 9,300 ha.

3 THE SWOT ANALYSIS OF BIODIESEL FUEL TECHNOLOGY IN ROMANIA

The SWOT analysis is an extremely useful tool for understanding and decision-making for all sorts of situations in business and organizations. SWOT is an acronym for Strengths, Weaknesses, Opportunities, Threats. The SWOT analysis headings provide a good framework for reviewing strategy, position and direction of a company or business proposition, or any other idea (new technologies). The SWOT analyses are used for business planning, strategic planning, competitor evaluation, marketing, business and product development and research reports.

Technological biodiesel is made through a chemical process called transesterification whereby the glycerine is separated from the fat or vegetable oil. The process leaves behind two products - methyl esters (the chemical name for biodiesel) and glycerine. The process involves drying the oil or fat to remove water. Methanol is mixed with sodium or potassium hydroxide catalyst and the resultant solution is mixed with the oil. After the reaction the glycerine settles and the biodiesel is drawn off and then washed. High technology processing plants have been constructed in central Europe A cottage industry of amateurs exists.

In terms of biodiesel SWOT analysis, one of the common strengths identified is that this technologies can provides a significant reduce of greenhouse gases and many pollutant emissions. High value and tradable (for Romania) product, supported by EU biofuels directive and future Romanian legal framework that will promote biofuels usage, are another's strengths.

Common weaknesses include: low acceptance of biofuels due to history and the strong position of fossil fuels, high costs without governmental subsidies, possible negative impact over food industry, immature biofuels market, lack of efficient distribution channels, dependency on policies, produces large volumes of waste water, chemical and engineering skills required, no commercial operations in the Romania.

The common **opportunities** identified include the following:

- Renewable Energy Sources development promoting by Romanian and EU legislation: RES are and will be continuously promoted;
- Increasing price of natural oil;
- Broad category of biofuels technologies varying from micro-scale to large-scale production;
- European directive on biofuels requires increasing quantities of biodiesel;

- In the future construction of biodiesel production facilities in the Romania are planned.

The strongest **threats** identified are:

1. Heritage privilege of natural oil;
2. Changes in taxation or policies for subsidies;
3. Withdrawal of the EU from the Kyoto Protocol;
4. Failure of deployment of new technologies;
5. Possible threats on biodiversity;
6. Taxation status of the fuel;
7. Health and safety issues from chemicals and explosion.
8. Disposal of wash water and other wastes

The main question facing biofuels technology in Romania is not whether they can work, but how they might be developed further. Any large-scale development remains stifled by numerous issues. The IEA, a sister organisation of the OECD, has identified several areas requiring extended research, but while there is a need to better quantify the various benefits and costs of biofuels, there is enough evidence to confirm that these fuels could represent serious alternatives to conventional fuels or, at the very least, complements to existing transport fuels. Energy and agricultural policies should aim to maximise the benefits of these fuels with minimum costs for governments and societies [3].

The SWOT biofuels panel

Strengths:	**Weaknesses:**
♦ Reduce greenhouse gases and many pollutant emissions ♦ High value product ♦ Tradable product ♦ Supported by the EU biofuels directive ♦ Future legal framework that will promotes biofuels usage ♦ High potential of biofuels in terms of contribution to RES (Renewable Energy Sources) targets	• Low acceptance of biofuels due to history and the strong position of fossil fuels • High costs without governmental subsidies • Possible negative impact over food industry • Immature biofuels market • Lack of efficient distribution channels • Dependency on policies • Produces large volumes of waste water • Chemical and engineering skills required • No commercial operations in the Romania. • The remaining material still needs to be recycled.

Opportunities:	Threats:
Renewable Energy Sources development promoting by Romanian and EU legislation: RES are and will be continuously promoted Increasing price of natural oil Broad category of biofuels technologies varying from micro-scale to large-scale production European directive on biofuels requires increasing quantities of biodiesel In the future construction of biodiesel production facilities in the Romania are planned	– Privilege of natural oil – The present process of liberalisation of the energy sector may lead to a (temporary) hesitance towards new investment projects – Changes in taxation or policies for subsidies – Withdrawal of the EU from the Kyoto Protocol – Failure of deployment of new technologies – Possible threats on biodiversity – Taxation status of the fuel – Health and safety issues from chemicals and explosion – Disposal of wash water and other wastes

4 CONCLUSIONS

1. While biofuel production costs are fairly easy to measure, the benefits are difficult to quantify. Biofuels can be expensive, at up to three times the price of petrol, though the gap has narrowed with recent sharp oil price rises. The high cost of biofuels has traditionally kept their usage down in IEA countries, though with oil prices rising and technical improvements, they are rapidly becoming more attractive.
   Also, with increasing production scale and experience, biofuel prices will likely drop. On the benefit side, increasing the use of biofuels can improve energy security, greatly reduce greenhouse gases and many pollutant emissions, and improve vehicle performance;
2. Biofuels production can also enhance rural economic development. These benefits are difficult to quantify as they are externalities, and not reflected in the market price of biofuels. Over the next decade the cost of producing advanced biofuels, such as from ligno-cellulosic feedstocks–the green parts of plants–may drop noticeably. In fact, prices may fall to below the costs of producing conventional biofuels, since the biomass feedstocks may be much cheaper, including crop and forestry wastes, and due to dedicated energy crops such as grasses or trees that can be produced on marginal lands;
3. From a greenhouse gas point of view, cellulosic ethanol is good news, since it is nearly carbon-neutral. The cost for reducing greenhouse gases from these advanced biofuels may drop to $50-$100 per tonne over the next decade, much lower than today's cost of using grain crops in EU countries [3].
4. The SWOT analysis approach is quite a practical way of studying the feasibility of technologies, market actions or other relevant aspects in several areas. In this paper the country specific SWOT analysis was also provide relevant aspects concerning biofuels usage in Romania.

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CLEAN SOLUTIONS FOR SHIPPING INDUSTRY

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***Abstract**: The Clean ship is a ship designed and operated in an integrated manner to eliminate harmful operational discharges and emissions. A ship that is constructed and can ultimately be recycled in an environmentally acceptable way, and one that is energy and resource efficient in its daily operation. A Clean ship operation maximizes the opportunities for safe and environmental navigation while at the same time providing all possible safeguards in the event of an accident. It requires a shipping sector that puts safety and environmental protection first, an industry with a "safety culture" at its heart. The aim of this work, Clean ship project, is to communicate the Clean ship* **-** *firstly to the Maritime Industry, but also to the general public. By proposing solutions* **-** *both workable actual solutions and future options, the project partners aim to stimulate stakeholders to plan a course towards a sustainable use of the seas and oceans.*

Keywords: *clean, ship, antifouling.*

1 INTRODUCTION

Since 2002 the International Maritime Organization has established measures and policies for the protection of the seas and oceans. It was considered necessary to take steps to improve the quality of the ecosystems. After the Bergen conference in 2002 it was decided to install an Issue Group on Sustainable Shipping in order to prepare proposals for the next Word Ocean Meeting on Environmental Impacts of Shipping. The idea behind the formation of the Issue Group for Sustainable Shipping was to give a new impulse to a better environmental performance of shipping. The need for this was highlighted by recent shipping accidents, which stirred political awareness on the issue. Examples of such issues are: establishing an ecosystem approach to management; conservation, restoration and protection of species and habitats; sustainable fisheries; reducing the environmental impact from shipping; prevention of pollution from hazardous substances; prevention of eutrophication; prevention of pollution from offshore installations; prevention of pollution by radioactive substances; promotion of renewable energy; marine litter and waste management. Shipping will be the most important subjects for the UE development while the aspect of enforcement will also be included (in relation to Shipping and Fishing). The main task of this work is the development of the Clean Ship concept, a completely new approach towards sustainable shipping [1],[2]. Issues as air quality, marine litter and port waste reception facilities are covered by the Clean Ship concept. The Clean ship concept is a creative way of looking for sustainable solutions for environmental problems related to shipping.

Fig.1. Clean Ship Concept

2 MARINE AWARENESS

2.1 Green Award

Every ocean going vessel should comply with (inter)national laws and regulations which are known and accepted in the Marine industry worldwide. The Green Award Flag can be awarded to vessels which are extra safe, extra clean. Green Award vessels are the vanguard of the international shipping industry.

A Green Award ship meets high, but manageable technical and managerial requirements. An increasing number of ports and nautical providers recognize the value of Green Award and offer special rates and other advantages to Green Award vessels.

The Green Award certificate confirms the high quality of the vessel and it contributes to a positive image of the ship owner with all the advantages this entails. More and more shipping-companies apply for a Green Award for their vessels. Green Award checks on a yearly basis if a vessel still meets the requirements.

For new categories, special Green Award requirements will be established and since 1 January 2008 a Green Award has been available for bulk carriers. New categories will, over time, be available.

2.2 Ecoports

The environmental policy at the Ecoport; Ecoport is one of the ports that will contribute to long-term sustainable development by committing itself to both large and small efforts. Below are some examples of what they do: Waste and sludge management. At the Ecoport, ship crew's are able to leave all kinds of waste products. Together with shipping companies, they have created more sorting possibilities than required by law. Shore-side electricity for ships. Within the harbor area, there are three guays that have facilities fore shore-side electricity. These facilities are also designed into all new quay construction, as well as during more extensive quay repairs, and can be implemented when requested by shipping companies. The electricity is produced by two wind power plants at Risholmen. Besides shore-side electricity is the electricity used to power the terminal lighting. Environmentally differentiated port tariff. A NOx rebate and a sulphur fee are being applied to encourage the shipping companies to invest in better technology and ship fuels with lower sulphur content.

3 ANTIFOULING

3.1 Anti-Fouling

Ships travel trough water and an unwanted growth of biological material such as algae and mollusks called fouling attach themselves to the hull. These organisms will slow down the ship and fuel consumption will increase. A clean ship can sail faster and with less energy. Chemicals industry developed effective anti-fouling paints. One of the most effective anti-fouling-paints contains the organ tin compound tributyltin (TBT). Environmental studies prove that organ tin compounds remain in the water, killing sea life, harming the environment. On 5 October 2001 The International Maritime Organization (IMO) adopted a convention which will lead to a world-wide ban on the use of anti-fouling coatings containing the biocide tributyltin (TBT). The generalized ban of TBT-paint has forced paint producers to look into alternatives to organ tin compounds. Underwater cleaning is carried out on moored ships or in harbors during loading and unloading by divers using of an impeller system with rotating brushes. Some cleaning companies developed a non-toxic hull concept. The idea was to coat the hull with a hard anti-corrosive system and to maintain it in this condition by regular underwater cleaning every several years. More sophisticated systems as robots are needed. A network of hull cleaning stations at all the important trade routes would be necessary. The cleaning should be entirely automatic, either by means of a remotely controlled vehicle or along the lines of a car wash system.

3.2 Silicone-based release system

Many company developed asilicone-based release system that opened up a new dimension in fouling control (ex: Hempel A/S). Hempasil systems feature a "non-stick" surface that is smooth and flexible, with exceptionally low surface tension. The technology is biocide-free. This provides an environmentally sound fouling release solution because the effect is due to the water-repellent physical properties of the surface, instead of the coating exerting a chemical effect on the surroundings. This provides two breakthrough advantages. Fouling organisms find it extremely difficult to adhere to a Hempasil-treated surface, and the smoothness of such surfaces cuts down on drag, thus reducing fuel costs by approximately 1%. The fouling is specially designed for vessels with a minimum average speed of 15 knots and a activity level of 75% or more.

3.3 Fuel Cell

The conclusion is that the production of fuel cells and the technology surrounding it still stand on a relatively low standard. Producers do not like to share their products and information with third parties yet. This made it sometimes very difficult to receive information. The last point of attention is that involved companies should meet one time to consult and that there may follow some nice projects and cooperation's.

4 FUTURE PROPULSION SYSTEMS

4.1 Common rail

Solenoid or piezo valves make possible fine electronic control over injection time and amount and high pressure provides better fuel atomization. In order to lower engine noise, a small pilot amount of fuel can be injected just before the main load, effectively reducing its explosiveness; some advanced common rail fuel systems perform as many as five injections per stroke. Common rail engines feature no heating up time, lower engine noise and lower emissions than older systems. In older diesel engines, a distributor-type injection pump, regulated by the engine, supplies bursts of fuel to injectors which are simply nozzles through which the diesel is sprayed into the engine's combustion chamber. As the fuel is at low pressure and there cannot be precise control of fuel delivery, the spray is relatively coarse and the combustion process is relatively crude and inefficient.

Driven by a computer (which also controls the amount of fuel to the pump), the valves, rather than pump timing, control the precise moment when the fuel injection into the cylinder occurs and also allow the pressure at which the fuel is injected into the cylinders to be increased. As a result, the fuel that is injected atomizes easily and burns cleanly, reducing exhaust emissions and increasing efficiency. In addition, the engine's Electronic Control Unit (ECU) can inject a small amount of diesel just before the main injection event ("pilot" injection) that reduces noise and vibration, as well as optimizes injection timing and quantity for variations in fuel quality, cold starting, and so on.

4.2 Solar energy

The term solar power is used tot describes a number of methods of harnessing energy from the light of the sun. It has been present in many traditional building methods for centuries, but has become of increasing interest in developed countries as the environmental costs and limited supply of other power sources such as fossil fuels are realized.

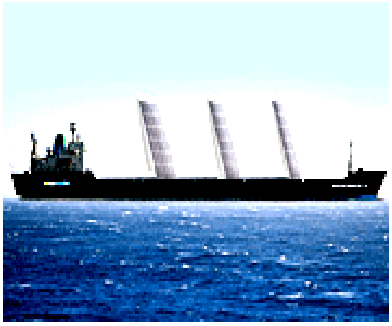

Fig.2. The solar sail technology on ship

A reliable supply of fresh water in urban areas is becoming a growing problem around the world. This concept of aqua tankers involves a series of supertankers specially designed and constructed for the carriage of potable water. Using the unique Solar Wing sail with solar cell array technology reduces fuel consumption and emissions by nearly 50% on the voyages compared tot the conventional tanker of this size. The aqua tankers solution uses existing off the shelf technology for all components of the operation. Significant savings over other transport systems are achieved through significant reduction of fixed upfront capital expense and relatively low energy consumption. Optional energy-saving innovations such as the solar sail technology would reduce fuel costs by 40 – 60%.

4.3 Skysails

Skysails Company has ideas about towing kite propulsion systems for modern shipping. By using Skysails ship operation will become more profitable, safer and independent of declining oil reserves.

Fig.3. Skysails ship operation

Fossil fuels are running out, that is a commonly heard phrase in the last few years. The problem is getting ever more pressing. Over the last few years the interest of the general public to reduce the damage we do to the environment increased dramatically. In an effort to solve these problems the search has started for alternative fuels. Rapeseed oil might be a promising candidate to replace diesel.

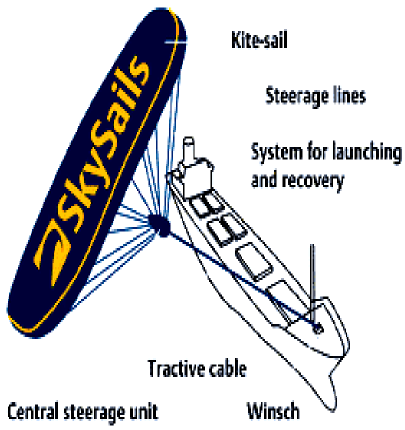

Fig.4. The Skysails in a auxiliary wind propulsion system

It is provided with a kite-sail, steerage lines, system for launching and recovery, tractive cable, central steerage unit and a winch. The kite-sail is not direct connecting to the ship but the sail is connected by a rope-system. Thereby it can be used when the wind is conditions are good and then the system is highly profitable. The engine always stays the main propulsion system but with the use of Skysails the fuel consumptions can temporarily be reduced up to 50%. The Skysails system is most efficient when the course of the ship is between 120 and 140 degrees.

4.4 Rapeseed oil

Rapeseed oil's biggest advantage over diesel oil is its inherent environmental friendliness. Furthermore this fuel is virtually inexhaustible. And if the added tax on rapseedoil is removed it will be even cheaper then diesel. Except for the technical information we also learned that the demand for a greener fuel is very strong. Despite this a lot of misconceptions rule around the use of rapeseed oil. The best example of this is the confusion between pure plant oil and biodiesel. And their effect on the environment. The biggest obstacle for the widespread use of rapeseed oil is an economical one. Mainly the tax on this fuel prevents it form reaching its potential. The good news is that surrounding countries have implemented laws and tax reduction to promote use of this fuel which will undoubtedly reach us as well.

5 AIR LUBRICATION

The technology of sailing on lubrication is based on the knowledge that air causes less friction than water. The reduced friction produces a saving of 10% to 20 % in fuel consumption. A grid of air chambers is fitted under the ship, into which a compressor is continually pumping air. The air reduces the contact surface between the water and the ship's hull. To prevent an escape of air bubbles due to the rolling of the ship and wave action, stabilizer fins are fitted to each side of the hull to keep the ship in horizontal position. The technology will be used in the future on slow vessels and on very fast vessels.

6 TREATMENT OF BALLAST WATER

6.1 Treatment of ballast water.

An almost empty or partly loaded ship makes use of ballast water to regulate stability and to keep her propeller under water. Ballast water allows ships to increase her draft or change trim. Generally ballast water provides safe voyage of the ship and her crew. Taking in, transporting and discharging ballast water leads to mixing water from one part of the world with water from another part. Annually 10 billions tons of water is transported from one area to another. The use and exchange of water in ballast tanks has become a seriously problem for the aquatic species and organisms in different ecosystems which disturb balance in local waters. Consequences are that some types of fish and other marine organisms become extinct. The water also contains micro-organisms, bacteria and viruses which can be risky for the health of people, fisherman's, people who eat fish and particularly for swimmers. As a reaction to the worldwide problem of organisms in ballast water, the International Maritime Organization (IMO) has formed guidelines for the control and management of ballast water on board.

6.2 Best practice company

Soon most ships must be provided with Ballast Water treatment installations. Different countries carrying out research for the best technologies to purify water containing harmful substances. Some technologies make use of filtration, UV radiation, electrochemical cells to erase aqua- organisms and plants which create problems for the marine environment and for human health. Treatments of ballast water can be combined and also perform at various stages during the process. For example the Dutch company Green ship has more than twenty-five years of experience in the field of international shipbuilding supply industries and marketing communications. Green ship has developed the Sediment Removal System which meets IMO regulations. The system prevents mixing of different organisms in different parts of world. For the ship-owners it means saving money by reducing the amount of fuel and transporting more cargo. Reducing sediment also decreases the amount of damage to tank coating and consequently less corrosion.

7 CONCLUSIONS

The Clean ship concept is an integrated approach in different means:

- to involve all stakeholders in the process: seafarers, ship-owners, charter parties, shipbuilders, designers, financers;
- the concept includes all environmental aspects of shipping and aims to stimulate the development of solutions;

- realizing the clean ship concept calls for several different instruments in the process: not just legal rules, but also financial instruments, intelligent logistic options, training, communication.

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CONSIDERATIONS ABOUT PROPELLER CARACTERISTICS FOR CAVITATION, NOISE AND VIBRATIONS REDUCTION

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***Abstract**: The ship speed of vessel has been increased in recent years. This work presents a general rule, been design rule when designing propeller to aim for highest possible level of propeller efficiency while keeping vibration and noise and hence cavitation at the lowest possible level. Less cavitation results in a large blade area ratio, whereas trying to obtain a high propeller efficiency requires the reverse*

***Keywords:** cavitation, noise, propeller.*

1 INTRODUCTION

The number of vessel equipped with controllable pitch propellers (CPP) has steadily grown in recent decades. Now, fixed pitch propellers (FPP) are used for vessel where simplicity and operation at sea are dominant. This includes tankers, bulk carriers and containerships.

Building reliable and efficient machinery, including fixed and controllable pitch propellers and we are continuously updating our propulsion systems. Development in our research include: integrate control systems with field bus technology, compact hub design, advanced hydrodynamics design and high-efficiency water jets

2 ESTIMATE OF THE PROPULSIVE EFFICIENCY [1]

Generally speaking, the largest propeller diameter gives the highest propulsive efficiency. However, the diameter behind the ship is normally limited by the draught of the vessel and the tip clearance.

For a first estimate, the propeller diameter based on the power and revolution rate can be selected using the following formula. This formula based on a series of propeller and the optimum selection of diameter and number of revolutions given the best propeller efficiency.

$$N_{opt} = 101\sqrt[3]{\frac{P}{D^5}} \tag{1}$$

where:
N_{opt} =optimum revolution rate (rpm)
P=propulsion power (kW)
D=propeller diameter (m)

This simple but reliable formula also makes it possible to check the tip speed of the propeller:

$$V_{tip} = \pi \cdot \frac{N_{opt}}{60} D = 5{,}29 \sqrt[3]{\frac{P}{D^2}} \tag{2}$$

Comparing the results for various applications shows that, given the power density (1000-1500) kW/m^2 for speeds 20-32 knots. The tip speed together with the inflow to the propeller is a dominant factor in the design of propellers, especially with respect to cavitation performance.

The propeller efficiency is mainly determined by given propeller diameter and required thrust. Based on momentum theory a relation can be derived to obtain the ideal propeller efficiency:

$$\eta_{prop} = \eta_{ideal} - 0{,}175 = \frac{2}{1 + \sqrt{1 + C_T}} - 0{,}175 \tag{3}$$

where:

$$C_T = \frac{T}{\frac{1}{2}\rho V^2 \frac{\pi}{4} D^2} \tag{4}$$

and:

T = propeller thrust [N]; ρ = water density [Kg/m^3]; V = the advance velocity [m/s] of the propeller $V=V_s(1-w)$ where V_s is the ship speed [m/s] and w is the wake fraction

This formula is a first estimate of the propulsive efficiency. Without the deduction of 0,175 the formula assumes a propeller with an infinite number of blade and no frictional or rotation losses. In practice the blade number reduces the efficiency and friction of the blades as they are drawn through the water and also the finite blade number. In total this adds up to about 0,175.

For a propeller with a larger wetted surface this effect is larger. The formula clearly shows the positive effect of selecting a large propeller diameter for a given required thrust. Normally this thrust is based on the thrust required to drive a certain size of vessel at the ship speed required by the owner.

Similar simplified relations can be derived for vibration. Depending on the tip speed and the tip clearance, the distance between the propeller blade tip and the hull, the propeller vibration is felt every time a blade passes the hull.

The presence of cavitation on the propeller blade tip strongly amplifies the pressure pulse on the hull. In general the pressure pulses on the hull: are inversely proportional to the tip clearance; increase with increased power density; increase with increased inflow disturbance from the ship.

The inflow at the propeller blade tip is much less then the ship speed, for single-screw vessel the inflow is a law as 50% of the ship speed. This implies that the blade profile of the propeller varies strongly in the angle of attack during one revolution.

3 PROPELLER DESIGN [1]

Many vessels today are equipped with controllable pitch propellers, especially vessels with an installed power of less 10000 KW. The engine driving these propellers cannot be reversed. The application of shaft-driven generators for the efficient generation of electricity of for heavy maneuvering requirements favors the application of CP propellers.

Fixed pitch propellers are applied when the vessel mainly operates at sea. Simplicity counts. However, there are limits to the operation of fixed pitch propellers. For instance the 2-stroke engine cannot operate below a certain number of revolutions, which will restrict the low-speed operation of the vessel. Controllable pitch propellers also make it possible for the diesel engine to absorb the full power in both bollard and free-running conditions.

In the pre-design stage, the main parameters are determined in close co-operation with the yard and the owner. Diameter, shaft speed and hub size are selected. In most cases a preliminary propeller design is made and discussed with the yard and the owner. The design conditions and off-design modes are carefully. This is especially important for dredgers, passengers and RoPax vessel.

Inputs from model tests for the propeller design are: self-propulsion test with stock propeller (and nozzle if applicable); open-water test with stock propeller (and nozzle if applicable); wake field measurements.

The propeller geometry is based on the following parameters: Chord length, pitch and camber, skew and rake, profile thickness.

The influence parameters.

Camber. Fine-tuning of the cavitation patterns is carried out by means of the camber distribution. The selection of camber is based on minimizing the cavitation extent in free-sailing modes, while face cavitation has to be avoided for part-load conditions such as operation on one engine.

Skew. The skew distribution has an effect on several items. The higher the skew, the smoother a propeller blade will enter the wake peak and thus will generate less variation in thrust. In addition, tip skew has a beneficial effect on the unloading of the tip.

Unfortunately an increase in skew will not always improve the propeller design! Excessive skew can result in leading edge vortices, which can be erosive or generate noise. The aim should be a good balance and combination with loading at the tip, and finding the optimum solution requires considerable skill. A high skew at the tip can also lead to high blade stresses. Finally, skew is one of the determining parameters for the actuating forces of the hub.

To summarize, a moderate to high skew is preferred from a hydrodynamic point of view and the skew distribution has to be balanced for strength reasons and actuating forces

Tip unloading. Unloading is accomplished by the pitch and chord length distribution. The larger the power density, the more tip unloading is required to reduce noise and vibration hindrance. The tip unloading in free-sailing conditions has evolved from a loaded tip to an unloading of the tip by about 50% following a specially developed circulation distribution in the tip area.

Blade thickness. The blade thickness is the result of a fatigue and static strength assessment using the Finite Element Method. Each propeller design is analyzed regarding

fatigue and peak loading. The mean and maximum stresses in the free-sailing conditions are determined.
It should be noted that behavior is different for fixed pitch propeller and controllable pitch propellers. For fixed pitch propellers the direction of rotation is reversed. This leads to increase loading on the area of the blade tip, which restricts the amount of skew that can be app lied for fixed pitch propellers. For controllable pitch propellers the direction of rotation is not changed and stressed are not critical.

Pressure pulses. Using the calculated cavitation pattern the pressure pulses on the hull can be calculated. The pressure pulses are related to vibration by means of the so-called "integrated force". When the propeller rotates, the force on the hull varies with the rotation. The variation in time versus the variation in size of the force generates noticeable vibration inside the ship. Depending on the strength of the vessel and the occurrence of resonance the vibration limits in the ship are either met or not

Tip clearance is clearly an important aspect in preventing vibration onboard a ship. Doubling the tip clearance reduces the pressure pulses and the integrated force by a factor of two.

4 OPTIMUM CONTROL OF PROPELLER AND DIESEL ENGINE [2]

A controllable pitch propeller can generate a given thrust or power with infinite combinations of pitch and shaft speed. Various control strategies can achieve the required propeller thrust.

The classical approach is to programme a pre-set combination between pitch and shaft speed, making it possible to control the generated power easily by a lever on the bridge. This so – called combinator control is ideal for stationary ship conditions and a propulsion system without propeller-shaft power take-off (PTO systems), such as shat-generators.

To avoid overloading the main diesel engine, this means in practice that load control is needed in addition to the combinator. The load control keeps the diesel engine load within the operating envelope of the engine. A combinator curve is designed taking into account engine requirements, the cavitation patterns of the propeller in various conditions, and the mission profile of the vessel.

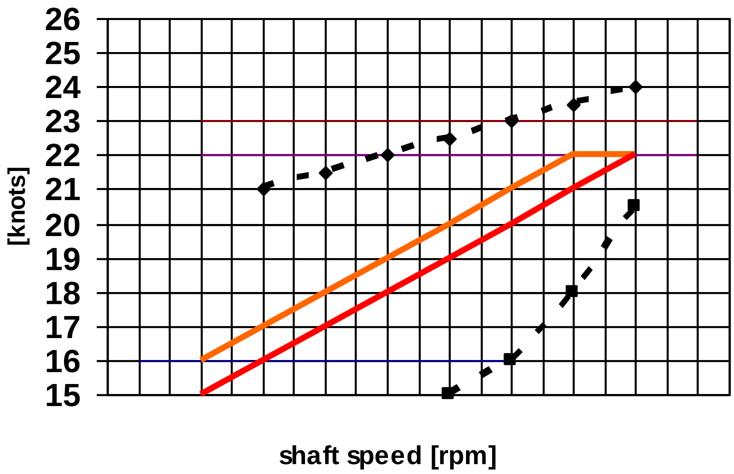

Fig. 1 Engine load limit curves and propeller cavitation limits

The load control reduces the pitch as required by the combinator in case of acceleration of the ship during maneuvering and when PTO power is taken. Figure 1 shows a power absorption diagram for a RoPax vessel. Shown are the operational limits of the engine for the two-and one-engine condition. Lines are plotted for a given ship speed but at different propeller pitch.

An increase in propeller pitch indicates a lower revolution rate and shows lower power absorption closer to the load limits of the engine. This is the result of a larger propulsive efficiency. Also plotted are dotted lines indicating the limits in cavitation for various pitch settings?

Given a number of revolutions at increased pitch more cavitation will appear on the suction side of the propeller and the pressure pulses will increase. The pressure pulses and the amount of suction side cavitation will be highest at the maximum power point at the highest rpm.

The same diagram also indicates the limit against pressure side cavitation. This appears when the pitch is reduced at given rpm. The propeller starts to cavitate on the pressure side and, if the pitch is further reduced, the propeller thrust in the tip area will become negative. The propeller will then generate an unsteady type of cavitation and this will be observed inside the ship as increased noise.

This is also demonstrated by Figure 2, which shows the measured noise levels for various control options. At constant rpm, reducing the pitch from full power to a lower power first reduces the propeller excitation thus the noise. Reducing the propeller pitch further will pass the point of pressure side inception. At the point where the thrust at the tip becomes negative the noise will increase again and be larger than when operating at full power. The use of a combinator will then reduce the noise level significantly. The level can be further increased when the wake distribution at the propeller is improved.

5 THE NEW DESIGN LINES

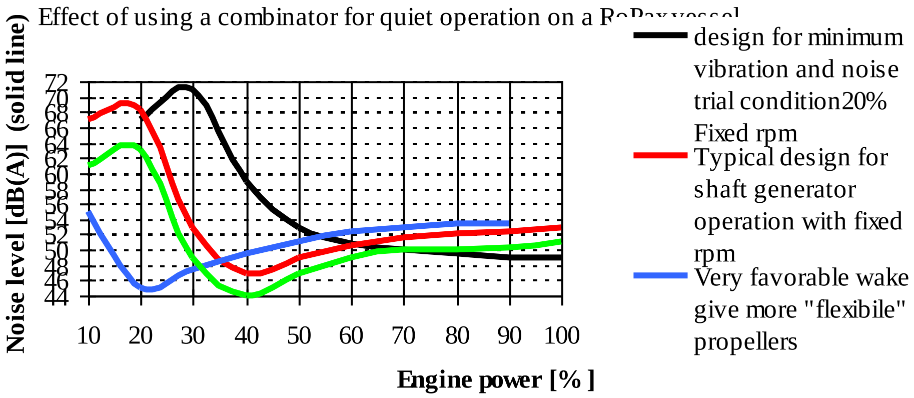

Fig. 2 Effect of using a combinator

Nowadays, in the context of pollution reduction and high costs of the fuel, the industry demands lower fuel consumption.

In response to industry demand for lower fuel consumption, and better environmental protection characteristics, Nakashima Propeller has developed a new high efficiency propeller, the Non-Hub Vortex (NHV).

Designed both to eliminate the hub-vortex phenomenon and to optimize the load distribution on the surface of the propeller blade, the NHV propeller type has been through both extensive model tests and sea trials and these are said by Nakashima to have demonstrated the significant benefits of the new design compared with alternative propeller types.

A hub-vortex originating from the back end of the propeller cap can have a number of undesirable effects, including energy loss and rudder erosion. Through improved blade geometry, the NHV propeller is intended to reduce, or even eliminate these effects without the need for any special devices or attachments. In addition, Nakashima says it has achieved improvements in load distribution by using the latest computational fluid dynamics (CFD) analysis and propeller lifting theories.

'Numerous' model tests have been carried out by Nakashima and these are said to confirm that the NHV propeller improves efficiency by about 5% compared with other standard Japanese propeller designs, and by 2%-3% compared with Nakashima's own Pressure Accorded Improvement (PAI) propeller. In addition, in comparison with conventional propellers, the NHV propeller improves blade-surface cavitations and excitation force by similar, or even greater margins (fig. 3).

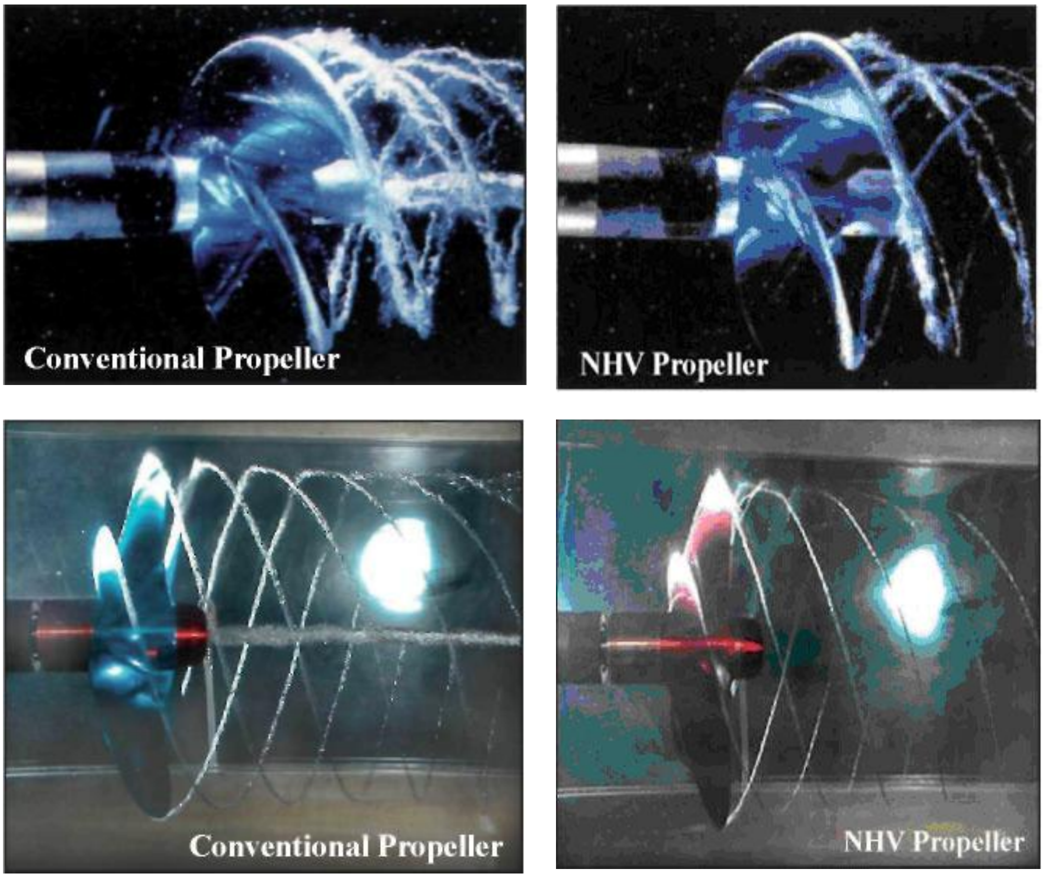

Fig. 3 Pictures during trials of the conventional and NHV propellers

Sea trials have also supported Nakashima's claims for the NHV propeller. A comparative analysis of a car ferry's performance with both the NHV and a conventional propeller showed a 2.3% improvement in the propeller open test (POT), and a 5.8% improvement in inverse POT. Based on these results, the NHV's effectiveness is rated at 3.5% - the difference in improvement in propeller efficiency represents NHV's ability to eliminate hub-vortex.

Nakashima has also carried out sea trials to compare the fuel consumption of a car ferry before and after the fitting of NHV propellers. A comparison of the average monthly fuel consumption, over a six month period, showed that there had been, on average, a reduction of 5% in fuel consumption, while there was a marked reduction in vibration as well.

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CONTRIBUTIONS ABOUT THE DESIGN OF WELDING SUPPORT STRUCTURE OF A NAVAL GUN

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Abstract: *Romanian Naval Forces are using cannons which have the possibilities to rotate in horizontal directions almost* 360^0*. This main property concludes the necessity of utilization of a gun carriage in a new concept, different from old known cannons. The paper proposes a new way to design and, after that to optimize the structure using new design methods and MEF technique, also to do verification during the artillery fire.*

Keywords: *naval, structure, gun.*

1 INTRODUCTION

Naval cannons are guns with large caliber. In the horizontal plan it is necessary a maneuver in an area of 3600 and also with the possibility to move quickly in vertical and horizontal plan. This fact implies a new design for the cannon, different from the old cannon systems. They have a limited horizontal movement and which used another kind of cannon carriage. The new model of support use horizontal platforms and vertical stiffening plate and use a heavy ball bearing.

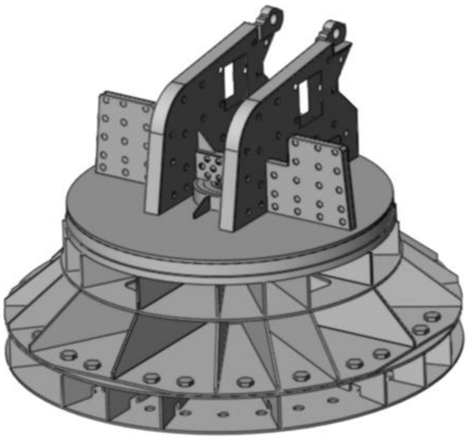
A new design of gun carriage is necessary to face the efforts in the new working conditions. Classic methods of cannons design are based on the theory that all the recoil energy is absorbed and consumed in a relative elastic medium. The fact that the new structure is fixed in concrete with bolts make that the barrel support, the concentration point of resultant forces, to be redesign.

To improve the design of a new model the author proposes the modern design methods, cutting edge fabrication methods and the optimization using dedicated software. Using the SolidWorks software for initial designs of the cannons and after that the CosmosWorks software, software integrated in
Solid Works software, for verification of the behavior simulating the real artillery conditions.

In figure 1 it is shown the new gun carriage and in figure 2 it is presented a detail of it.

2 USING THE MEF METHOD ON 130 MM CANNON

The dimension and the number of finite elements are stabilized automatically. This solution is the most appropriate solution to determine the stress and deformation in the new structure.



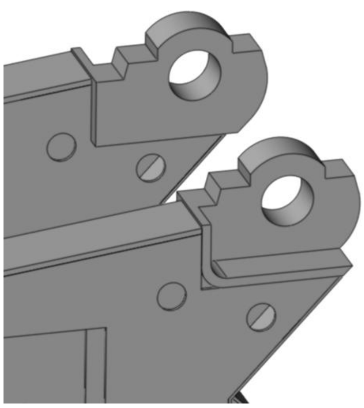


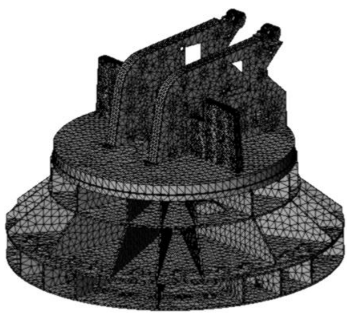
Figure 1. The geometry of the new *Figure 2. A detail at barrel support Support*

To obtain the best results is used convergent method. The right solution is stabilized in simple cases through analytics methods, and the final solution is determined using real measurements like electric strain measurement or photo elasticity or other ways like test on models or other analogies.

To use finite element method it is necessary same knowledge about the finite element library you have (how to use a certain type, appropriate to certain geometry and a certain situation necessary to resolve) and a certain experience necessary to a fine mesh enough to obtain a sure solution simultaneous with a quicker solution in real time.

For complex structures obtain from different geometry elements is necessary accuracy in transition from a certain finite element to another using the proper one. The same situation is used in case of different kind of geometry or different materials. The simulation will work properly if the coupling nodes case is handling with care.

In figure 3 and figure 4 are presented the mesh of the structure and a detail of mesh in barrel support.



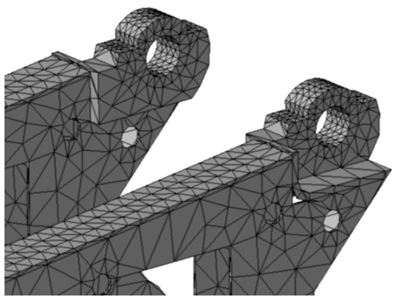


Figure 3. The mesh of gun support *Figure 4. Detail of mesh in barrel support zone*

3 STRESS AND DEFORMATION ANALYSES OF THE SUPPORT STRUCTURE OF A GUN DURING GUN FIRING AT 450

The values of the forces cannon carriage are presented in Table 1

Table 1 Force values

$timp_j$ =	Fx_j =	Fy_j =
0.001	$6.2374\cdot10^5$	$6.3574\cdot10^5$
0.009	33152.4162	45152.4162
0.034	$2.1366\cdot10^5$	$2.2566\cdot10^5$
0.038	$1.2108\cdot10^5$	$1.3308\cdot10^5$
0.094	46790.089	58790.089
0.097	$5.6024\cdot10^5$	$5.7224\cdot10^5$
0.12	$1.7682\cdot10^5$	$1.8882\cdot10^5$

where the coordination system is presented in figure 5:

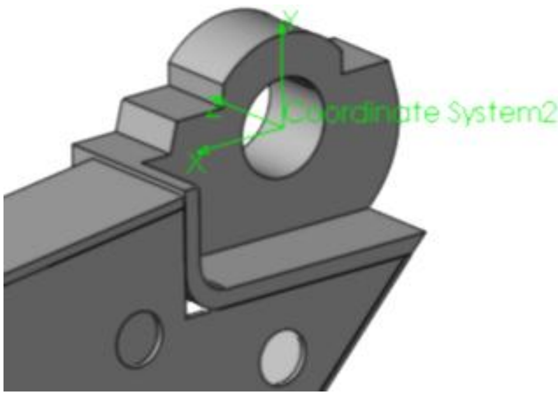


Figure 5. The coordination system

The von Mises stress in inferior support's ribs, represented in figure 6, is analyzed in nodes 16335, 16.336, 16.337, 16.338 şi 16.320 (fig 7) and in nodes 20.064, 20.116, 20.117, 20118, 20.119, 20.120 şi 20110 (fig.8), la momentul), at t=0,001s.

In the same nodes from figures 9 and 10, is analyzed the tension at the upper line of ribs, at t=0,022s (figure 9) and at t=0,12s (figure 10):

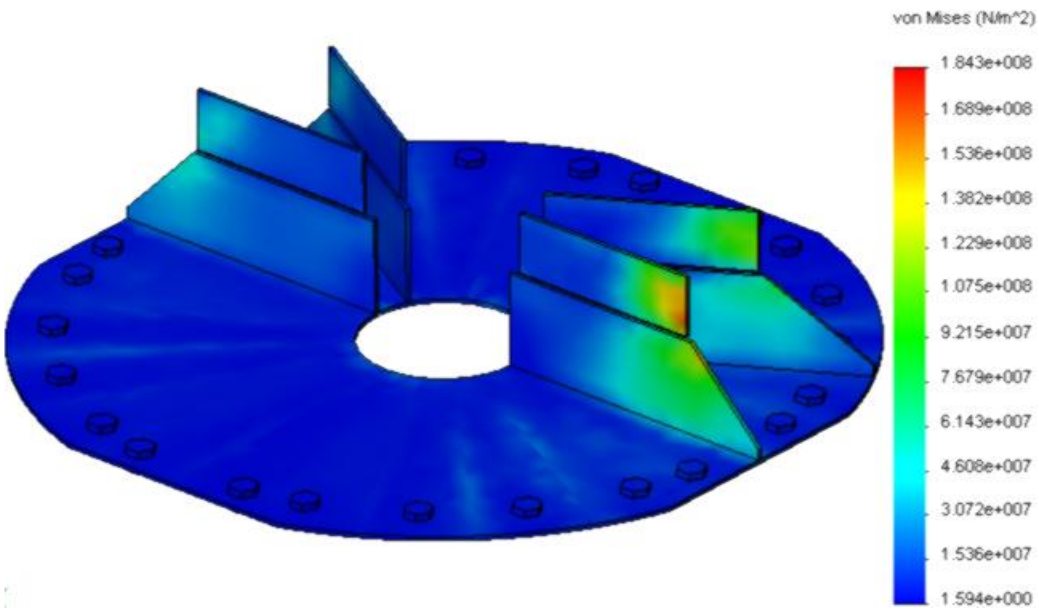


Fig. 6 4.41. Von Mises stress at t=0,001s for 45 °

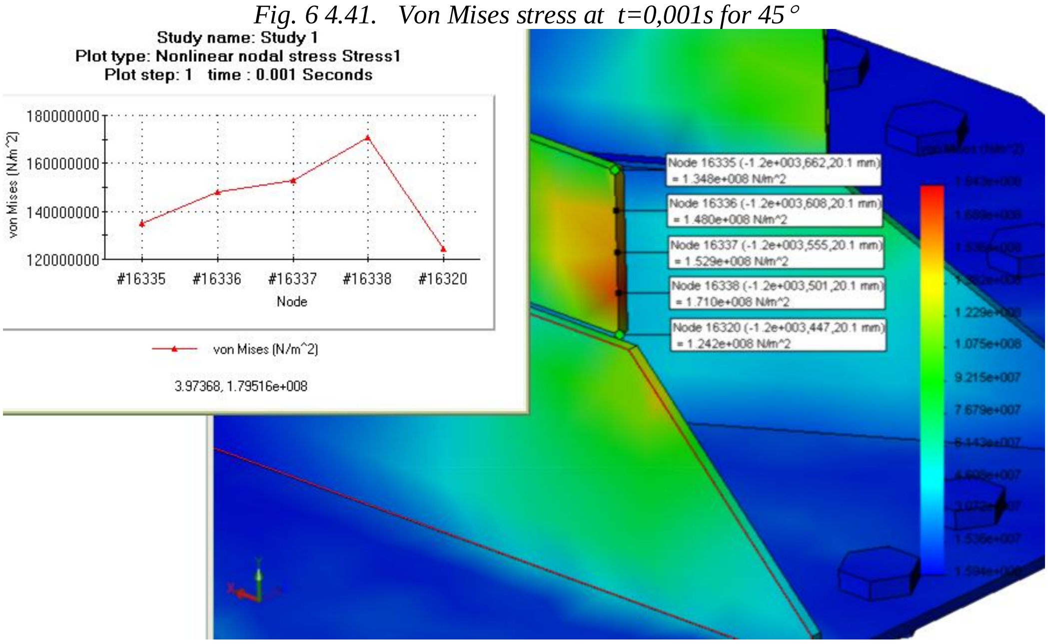


Fig.7 The variation of von Mises stress throw the most solicited ribs, (the on in the firing plane – xoy) at 0,001 s

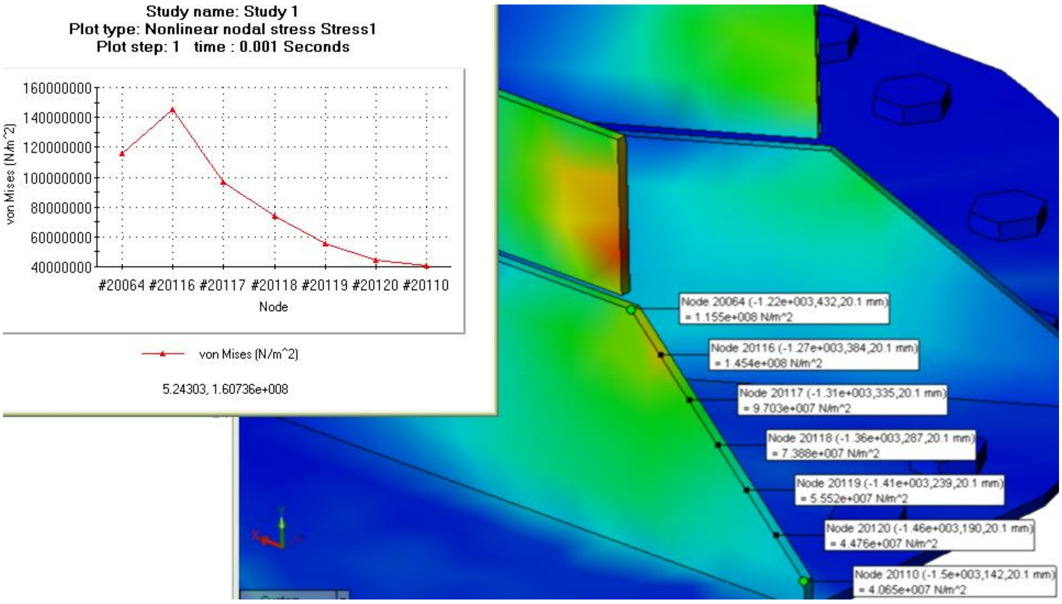


Fig. 8 The variation of von Mises stress throw the most solicited ribs, (the on in the firing plane – xoy) at 0,001 s at 45 °

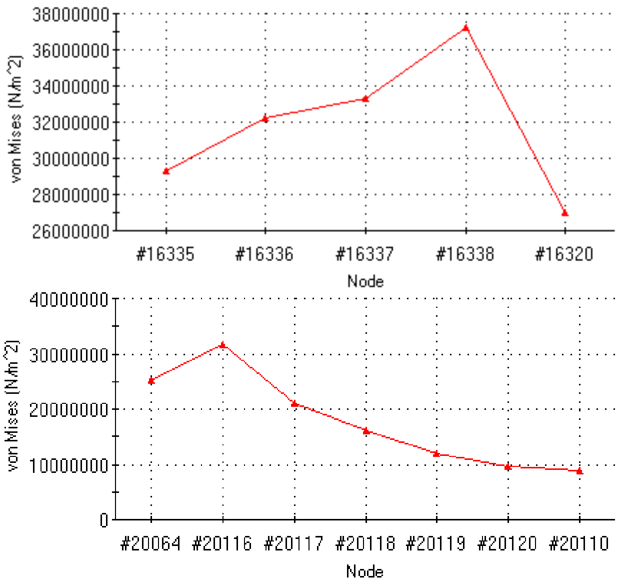
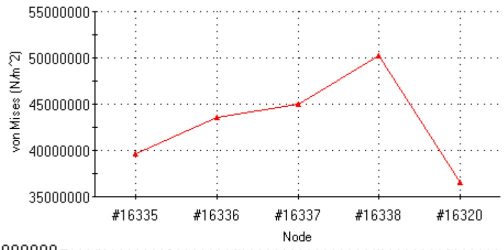


Fig.9 The variation of von Mises stress throw the most solicited ribs, (the on in the firing plane – xoy) at 0,022s



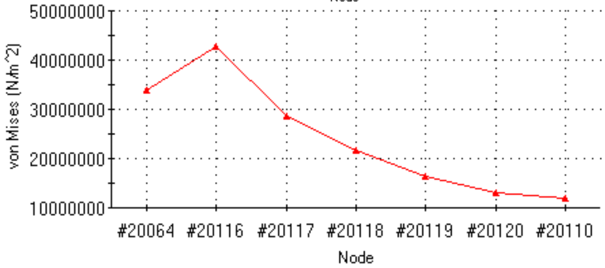


Fig.10 The variation of von Mises stress throw the most solicited ribs, (the on in the firing plane – xoy) at 0,12s

4 CONCLUSION

Starting the design of the new structure and all the necessary checking by gun shooting in special ranges it is important to submit to experimental verification the new structure. The accuracy control during cannon shut reveal the correctness of constitutive elements take in account the fact the strain in materials is below the safety limits for dynamics situation. This accuracy control together with the welding controls determined a complex of verification methods used to maintain the safety while operating with naval cannons, a new product with long working life in exploitation. The finite element method completed the method used to verify the accuracy of the design of a complex structure, which supports a special situation: a shock effect of cannons shoots.

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INVESTIGATION OF THE POSSIBILITIES TO EXTEND THE CONCEPT OF STABILITY TO MILITARY ASSETS

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***Abstract**: The stability of military vehicles is a new concept that was analysed in detail in my doctor's degree paper. In this work, we will try to apply this concept generally at the level of military assets. The concept, the definition and the stability factors are presented in the first part, whereas their interdependence will be analyzed in the second part. Because it is a new concept, we had difficulties in translating it. The word "stability" will be used in spite of the fact that sometimes the word "durability" can also be met. This term could be confused with the older exploitation characteristic "durabilitate" that has more the meaning of reliability.*

***Keywords:** military, asset, stability.*

1 THE STABILITY OF MILITARY TECHNIQUE ASSETS – CONCEPT, DEFINITION, STABILITY FACTORS

In the NATO Romanian Army, taking into account the alliance partners' expectations, it is necessary to improve the ways of intervention by increasing the stability of act capabilities of the specialized squads. The improvement of the global stability of the military technique assets can be accomplished only by borrowing and adapting some data taken from other fields. These details and the other existing ones related the act tactic and combat management technology have as a result the improvement of initial data in the system of the act capacity, and through a proper algorithm, the result will be the optimization of the combat stability factors and, finally, the success of military actions.

The stability is the reliability of the military technique assets to which a practical and tactical assembly of measures and preoccupations is added (the capacity of military technique assets and people to avoid the wastage, to avoid in time the enemy's gun strikes and their ability to fast recover their strike, fire, maneuvers and protection capacities) that guarantee the fulfillment of the intervention.

In order to analyze and understand the concept of stability, the stability factors are studied thoroughly: the performances of military technique assets, the reliability, the efficiency of maintenance and maintainability works, traffic specifications, combat service, combat service support (logistics), the quality of the substructure, the management of the human resources and the co(-)operation for support.

After that, their interdependency is studied. In other words, it could be said that the possibility of a military system to accomplish its mission as good as possible, could be better expressed by studding thoroughly the stability factors taking into account their reciprocal influence.

In conclusion, analyzing the behavior of military system related to its stability, it could be expressed to what extend the act system technically suits its missions.

Conclusions drawn from the analysis of stability factors:

- **The performances of military act systems**

The maximum performances which can be reached by a military system are very important, especially in bad moving conditions. The promptness of the intervention, its quality, the way the people who fulfill it are protected and supported depend on the maximum level of the performances of the military technique assets. For instance, this is the reason why the larger and high crossing capacity vehicles are widely used for mountain areas. On the other hand, the engine power, the maximum torque, the adherence, the maximum ramp, drivability and roadability of the vehicle, different methods used to improve the crossing capacity have a great importance in mountain areas. The investigations done in the country and in the military range for the mountain rangers as well as in Bosnia-Herzegovina where Dutch vehicles were used, Mercedes Benz 290 G 4WD (off-road), Volkswagen Transporter, DAF 4t and DAF 10t YWZ (DROPS) trucks, have revealed the aspects mentioned before.

- **The reliability**

The second important factor of stability is the reliability because of its direct influence on the performances of the military systems. As we know, during exploitation, the technique assets change their performances in a negative way because of the worn out of their parts and ageing of some component materials. It is important for the technique assets not to undergo a major malfunction during intervention because these would compromise the mission. That is why, it is very important for the military technique asset to be chosen in a period of working-exploitation not immediately after a repair and not after a long working period without interruption, because these would increase the probability of damaging during the intervention.

It is very interesting to keep watching working in service of DAC 887 R off-road recovery vehicle. This will be presented in the next table. We have to point out that its exploitation was done in a mountaineers' base most of the time during the cold period.

My military base has received the off-road recovery vehicle DAC 887 R in 10.09.2002 with 5195 equivalent kilometers. It was built in 1994 and it had a good working condition with but I have to make some affirmation: the clutch had been changed with another new one, the gear box was blocked in fast range of speed, the electrical system had a short-circuit at the behind marking lamp and, and the most important thing, the water-oil exchanger was improvised.

The recovery vehicle off-road DAC 887 R can fulfill its mission when driver and maintenance mechanics operate it very carefully but still they have to observe very strictly the maintenance and operating conditions. It is necessary to increase the workmanship of the complex systems, electrical equipment and air system, and the gear box has to be improved in order to shorten the time to change the gear box steps mainly when the driver changes the range speed from fast to force or from force to fast.

Equiv. km.	Date	Technical interventions (disturbances)
5195	20.06.2002-10.09.2003	- water-oil exchanger fissured $\Rightarrow$ makeshift; - clutch changed; - electrical system intervention; - inner tube changed.
6161	12.2002	- water-oil exchanger changed; - the air pressure changing installation fixed; - one thermostat changed; - the habitacle air-heating installation (“the scirocco”) fixed; - capstan overhauling; - clutch master cylinder changed.
6676	21.02.2003	- supply pomp valve changed.
7262	10.03.2003	- the whole block of electrovalves changed ; - the regulating system for differential pinion and power stage control fixed.
7401	22.03.2003	- discharge valve changed.
9245	13.07.2003	- water pump changed.

- **Maintenance**

Maintenance represents all the organizational and technical activities done in order to maintain and re-establish the technical state of a product so that this product could fulfill all the functions it was created for. The optimization of the exploitation of the military technique assets in military activities can be done only if the maintenance work was very well organized during the period of peace.

Maintainability or, in other words, the easy way to repair, maintain and check the military technique assets, influences the activity of the maintenance teams. The capacity of the military technique assets to allow the maintenance team to intervene in good conditions influences the most its activity, especially in difficult working conditions. The crisis/lack of time, space and of conditions to make the work easier induces the premises of a failure regarding the possibility of the disabled technical system to be made functional again as soon as possible. It has an indirect influence during the intervention and it depends again on the manager’s professionalism to choose the vehicle that needs high quality maintenance work done on time. Two different examples of the same mechanical system, the off-road DAC 887 R truck: if the change of the two thermostats can be done very easily due to accessibility, in the case of the breakdown of the stuffing box from the water pump, besides its difficult diagnosis, it is very difficult to repair it because the pump is geared to by the distribution kit, and not by the belt and the driving pulley from the outside of the crankshaft housing.

- **Traffic specifications**

The planning of military transport to interventions is one of the most important parts of moving organization activity and it is done following the orders of the superior echelons. Many times the reconnaissance missions are very important. The initial reconnaissance of the field in order to take into account the real rolling conditions to choose the best route, military technique asset, its position into a possible convoy as well as applying some coefficients which consider some unexpected elements becomes vital. And again, the human factor has an overwhelming importance.

We suggest the existence of an intervention plan for the isolated targets in case of terrorist attack. This plan has to consider the main access routes but and at the same time has to taking to account the other structures specialized for these kind of actions. That is why we made up a simulation of the antitero intervention of a mountaineers platoon to a target isolated in the mountains.

- **Combat service**

It represents all the measures taken in order to protect the troops from the surprising attack of the enemy, in order to give them the possibility to engage on time and in a organized way in a fight, in order to keep combat capacity and to fulfill their missions. The most important part of combat service is the reconnaissance. To draw up an intervention plan an initial detailed reconnaissance of the main access routes is needed. These could be done with the support of civilian factors such as foresters, indigenes and mountain gendarmerie and rescue mountain team. During fighting, a permanent air supervision, which keeps under surveillance the area, is obviously necessary.

- **Combat service support (logistics)**

It has an overwhelming importance during training the fight, but a small one during the actual fighting. The supplying of the logistics resources on time and in a sufficient quantity is necessary in order to assure a quick and prompt intervention.

- **The quality of the substructure**

The choice of a suitable route in off-road conditions is decisive for the fighting. It can bring about an important advantage but, in the opposite situation, it can provoke the failure of the mission. That is why the theoretical study of the field on the map, its practical study and by using other means must be done in detail.

- **The management of the human resources**

Many times the supplying of human resources is done to complete the necessary personnel of the units, because the fighting casualties or because personnel deficit caused by other reasons.

This requires monitoring, centralizing and analyzing the data concerning casualties and the level of personnel employment, drawing up and sending the personnel request, receiving, repartition and, the permanent connection with military local offices.

The handling of military technique assets can be very difficult, stressing to the maximum both the technique asset and the operator because of difficult conditions of the mission. The last one has to know very well the theoretical notions about the operation of the technique asset and, that is why the decision of the manager of the mission, regarding the choice of the operator, is very important too. The operator's training level as well as his partner's (for vehicles we mean the vehicle's chief) can influence in a decisive way the operating mod of the technical system. That is why, it is necessary, for the very important missions, to use only very well trained personnel, capable of fulfilling the mission without any problems.

For the military vehicle, in Romanian Army, the assignment of vehicle's chief should be more important helping the driver to overcome the difficult situations. The crossing capacity of military vehicles used in mountains depends a lot by the *human factor*. The training level of the driver and of the vehicle's chief can influence in a decisive way the operating mod of vehicle. That is why, it is necessary to use in mountain areas only the personnel very well trained for driving vehicles in these kind of conditions. The role of the vehicle's chief should be more important helping the driver to overcome the difficult situations. Otherwise, in N.A.T.O. armies, the vehicle's chief is called "*co-driver*", this one being the second driver. His assignment is to supply the driver with all the necessary data in order to make the driving easier at any time. Besides that, the responsibility of the mission is equally of the driver and of the co-driver. These two can change places any time, reversing their assignments. The result is that, for this kind of situations, the driver-vehicle system has a higher stability because of the efficiency, which is better in these situations because there are two specialists, and also owing to the fact when one of the two drivers has some troubles to accomplish his mission, the second one will replace him without any difficulty.

We will give an example of increasing the stability of the vehicles through an efficient management of the human resources. The place of action was Bosnia-Herzegovina, and the people were the drivers from the Dutch-Romanian Mixed Platoon from SFOR 16. For six months the vehicles of the Dutch Army (used by the platoon) rolled on the average 30000 km each. They excelled in a high reliability and in economic and dynamic performances better than the vehicles used by Romanian Army. This working style allowed an intense exploitation, without any problems, and in emergency situations even their overstraining (their continuous rolling up to 60 hours) was done without damages. We pointed out the situation when from 6 YWZ DAF 10t from different reasons (the oil changing operation, the malfunction of the hydraulic system, accidents) only two trucks were still operational. These two trucks rolled without stopping for three days, me (the commander of the platoon) and the Dutch colleagues from the Dutch company were in a emergency situation when 14 containers had to be carried on this route for three days. The distance was 360 km, the average speed was 60-65 km/h. 1/3 from the route was in the mountains (the average speed 20-30 km/h). The quality of the road was very good. The YWZs could roll without any problems with 90 km/h in maximum load conditions. The schedule of the drivers was: 8 hours of mission (6 hours driving, 2 hours in rest places and load-unload the containers), 8 hours of rest and sleep, following the planning made up before (without too many papers!). The permanent link between the drivers and me was kept through cell phone and through SATCOM signal system for the emergency situations, thus eliminating dead (lost) time. For 72 hours the engines of the trucks did not stop! In order to optimize the transport, the official documents between driver and vehicle (the taking over act, the daily unit order, the drivers name written in vehicle's document) were eliminated, this being approved by the

Dutch commander of the company. In the cab there were two drivers all the time and they were capable to switch each other when one of them got tired.

- **Co(-)operation for support**

The co-operation represents an activity used to ensure the working together of the forces taking part in the mission (in time, space and actions), cooperation based on the plan of the action and on the coordination done by the commander in order to concentrate and total their efforts, the aim being the success of the mission.

This has to be permanently assured during the mission and, when from different reasons it is lost, the commanders will give emergency orders to reestablish it, mainly the links for reciprocal informing.

Speaking about the support, specialized forces from the Romanian Army can receive missions in order to detect, keep watching and even take actions against terrorist groups or they can use their technical methods and assets in order to over look the air and land activities.

In a real intervention to an isolated target in the mountains, it could be said that the cooperation has the greatest important because it ensures the working together of the forces taking part in the mission and maybe the participation of the civilians in order to concentrate and total their efforts, the aim being the success of the action. If the cooperation between different structures from the Army was analyzed before, some details about the cooperation with the civilians and/or the other governmental institutions will be presented.

Eventually, we could say that the possibility for a vehicle to fulfill its mission in perfect conditions could be better expressed by the thoroughgoing study of the stability factors taking into account their reciprocal influence.

2. THE INTERDEPENDENCE OF THE STABILITY FACTORS

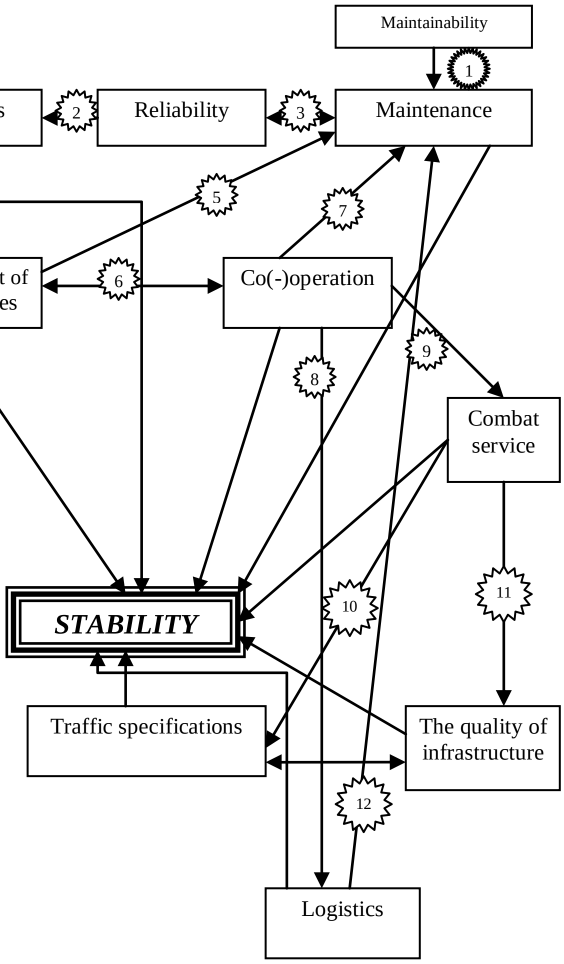

Fig. 1

The explanation of connections (Fig. 1):

1. The higher or lower maintainability indirectly influences the rapidity and the quality of the execution for maintenance operations and, sure, in an indirect way, the stability.
2. The decrease, sometimes very low, of vehicles performances, happens because of the reliability of global system. If the reliability is higher, the performances will decrease less and in a longer period of time.

3. At the same time with the increase of the easiness and the rapidity of maintenance the reliability parameters increase too, and the inverted phenomenon is true because if the reliability is high, the maintenance interventions are more rare, easier and faster; that means the maintenance parameters are higher.
4. If the management is a modern one, the operators are well trained, the performances of technical systems can be used to maximum; it is obvious that the manager of the drivers has to apply the principle "the adequate person at the adequate place", because, it is not necessary only the drivers to be very well trained, but, through joining more factors, the professional experience, the training level, behavior features, the decision factors must choose the fit people to accomplish the specific assignments. In case of missions abroad, the differences between the civilizations and cultures have to be regarded very carefully. The managers of the human resources and the commanders have to take into account these ideas.
5. This thing has to be applied in the case of maintenance teams; moreover, they have to be trained in order to be specialized in some domains to increase the workmanship and the rapidity of the execution; also, during the training program of workmen and operators, the teaching of principles and systems will be underlined at first and after that each of them will be specialized in one domain; so, the receiving of other kinds of military technique assets will be without any problems.
6. The general level of training increases because of the change of experiences between different domains.
7. The maintenance could be easier by cooperation with the superior echelons especially for difficult situations.
8. A high combat service support could be ensured by co(-)operation, especially for missions abroad but only when the frictions caused by the differences between civilizations and cultures do not appear.
9. A high combat service could be ensured by co(-)operation, especially for missions abroad; some examples: reconnaissance missions, antiaircraft defense, electronic fighting.
10. During reconnaissance missions, the reconnaissance of the field could be executed and with the support of the obtained data the decisions about traffic specifications will be made.
11. During combat service the protection against sabotage acts is also ensured; this fact directly influences the quality of the roads.
12. The method to execute the maintenance depends on the rapidity and the quality of the supply with tools, devices, spare parts and POL.

THEORIES CONCERNING THE DISCOURAGEMENT OF THE POTENTIAL ENEMY, SUPPORTED BY EFFICIENT STRIKING MEANS

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Abstract: *The modern armies have at their disposal very efficient armament and weapons that ensure the qualification for achieving the immediate success after thoroughly planned and performed joint military operations. The specialists have also developed theories that are discouraging for any potential adversary who would try to oppose resistance. The military conflicts in the world from the last 20 years have clearly shown that the theories and the efficient weapon systems used have proven their stability and have greatly increased the discouraging character. Starting from this "cruel reality" we intend to present concisely the discouragement theories launched by the states with powerful armies and also the weapons systems meant to support the implementation of these theories. We consider that each state that intends to approach a military conflict must thoroughly analyze the contents of these theories and to determine if it is capable to antagonize the destructive effects of the weapon systems of the potential adversary. Ignoring these problems inevitably leads to failure, followed by major political, economical, military repercussions.*

Keywords: *enemy, army, conflict, theory.*

1 DISCOURAGEMENT THEORIES

According to our opinion, the most important discouragement theories developed by the states with powerful armies are the following: [1]

a) The "*low intensity conflict*" theory that was developed by the Americans after the Vietnam war and aims at:
   - Ways of deploying the forces in non-war circumstances, for preparing and managing the crises;
   - Establishing the missions of the buffer forces, the peacekeeping forces as well as of the issues concerning actions of reconstruction, humanitarian assistance, fight against smuggling weapons and drugs and illegal immigration;
   - Increasing the role of Special Forces, the actions of which cannot be delayed or hindered, due to the training and endowment degree of these structures.

b) The "*cybernetic or strategic information warfare*" theory stipulates that the bombs and bullets are past, and the war is conducted in the cybernetic environment, defined as "*global information infrastructure*" or "*the sum of global communications and of computerized nodes*". Conducting a non-violent warfare constitutes an older vision of the military specialists, based on their desire to start the cybernetic war against the enemy state information infrastructure.

c) The "*the cybernetic warfare, the radical vision*" theory stipulates that a complementary element of the cybernetic war is constituted by the high quality stake of using the information, by permanently searching an answer to the question "What is the best information for the armed forces that one can get?". In the central position of the military universe are not to be found the Land Forces, the Air Forces or the Naval Forces, but the information about the friendly or enemy forces and the capacity to exploit the information domination.

This strategy does not exclude the most efficient fighting means, but it also studies the ways and methods in which their role should be minimized and this fact should be accepted even by the adversary. This is in fact the effect of guided information, based on which one can lose the balance in assessing even the own value.

d) The "*much ado about nothing*" theory stipulates the fact that an armed conflict or a war is thought of within the framework of using the Air of Naval Forces, the electronics only helping them to accomplish their missions. This theory was launched by those who consider that man has the dominant role in an armed conflict or war, in the sense that the man controls the mechanics and is able by his physical presence to determine the result of the joint military task he is engaged in.

The military specialists from this category support the idea that the new technological dimension of the war is given too much attention as compared to the role it plays, under the circumstances in which man plays the dominant part in a conflict.

e) The "*true revolution takes place in the air*" theory stipulates the fact that the technological revolution has left its mark upon the Air Forces. Presently, but also in the future, the aviation will play the determining role on the battlefield, because it is endowed with ultra sophisticated means, capable of deciding the resolution of armed conflicts. The Air Forces help, by their actions, the Naval and Land Forces in a decisive manner, so that their actions become futile or just formal.

f) The "*the outer space constitutes the true revolution*" theory that is supported by a reduced number of NATO military theoreticians, stipulates that the true and determining superiority can be achieved only from space.

In their opinion, the military activities depend on the technical means placed in the outer space and the one who loses the battle for the space or in the space, will lose the war (on ground, sea or air).

g) The "*a revolution in security relationships*" theory stipulates the fact that it is a priority to analyze the sources and fundamental character of the conflict as compared to the military tools of solving the conflict.

The entire ability will consist not in the capability of a state of rebuilding or building its security, but in the capability of protecting the security it has by political, economical, cultural, etc. measures.

From the presented theories and concepts analysis we can draw the following conclusions that constitute the fundamental elements in the evolution of strategy concepts of preparing and conducting the armed conflicts or wars, with or without the existence of an adequate general protection system:

- the aerial-ground battle is dominant and this imposes the large scale use of the high-precision reconnaissance-striking systems, which have highly destructive characteristics;

- the war has several dimensions, but the technological one is the most important, because the *weapon* was modernized and the *counter weapon* was left behind;

- the informational warfare that rises on the horizon can neutralize the superiority of raw force, such as the mass destruction weapons;

- the armed conflict or war in the future will be conducted on the street, in institutions, factories, lodgings, etc.;

- the information will play a more and more important part and it will not come from the quantity of aircrafts, tanks, battleships but from computers, and the result of the armed conflict or war will be decided not by those who are facing one another on the integrated (or extended) battlefield, but by those who are behind this.

2 EFFICIENT STRIKING MEANS THAT SUPPORT THE DISCOURAGEMENT THEORIES

2.1 High precision reconnaissance-striking systems

Among the efficient striking means that support the discouragements theories are the high precision reconnaissance-striking systems, which constitute the ultra developed means of reconnaissance and target acquisition for aerial and covered or uncovered ground targets within the fortification works and their destruction (neutralization).

The most developed high precision reconnaissance-striking means from the endowment of modern armies are: AWACS; ASSAULT – BREAKER; SOTAS; PLSS; AXE; JSAK; WILD-WEASEL; BOSS; WASP. [2]

The AWACS command – reconnaissance system is to be found in the endowment of the strategic echelons of the USA armed forces and is designated for the aerial radio-electronic reconnaissance of the aerial weapons and for the weapons from the enemy air defense, as well as for coordinating the fighter aircrafts until the launch of the air-air rockets on the targets. [3]

The system presents the following main characteristics:

- it acquires the covered or uncovered ground targets up to the distance of 400 km, and the aerial targets up to 600-700 km;

- the number of covered or uncovered targets acquired simultaneously is up to 600;

- it leads simultaneously 30 -60 interception aircrafts above the covered or uncovered targets;

- it patrols during peace time on a distance of 100 km, parallel with the enemy border to discover his active defense alignments;

- it patrols during war time on a distance of 150 -200 km, behind the contact alignment to identify the enemy defense alignments, as well as to coordinate the fighter-bomber aircrafts in order to destroy these alignments.

The ASSAULT BREAKER system is designed to perform reconnaissance by radiolocation and to destroy or put out of use the uncovered armored enemy vehicles which are to be found up to 180 km distance from the contact alignment.

The system is also used for striking the command posts from the tactical and operative depth. [4]

The system, which is to be found in the endowment of the operative echelons form USA, Germany, England and Italy, present the following characteristics:

- it engages enemy covered or uncovered targets placed in the depth, up to 100 – 160 km;

- it patrols up to 40 – 50 km to the contact alignment, acquires and engages the uncovered tanks, military transport convoys, as well as the arsenals containing strategic supplies, concealed and protected with a thin ground cover;

- it acquires targets up to a distance of 200 km and surveys simultaneously 12 uncovered tanks;

- it engages targets on a surface of 2.3 x 2.3 km and guides simultaneously 2 rockets on a military or ground target with a precision of about 50 m.

The long distance target interception system SOTAS is to be found in the endowment of the tactical echelons of the USA, Belgium, Germany, England and Italy armies and has the capacity of acquiring uncovered mobile targets, found up to 60 - 80 km from the contact alignment and to transmit in short time the necessary data for the aviation, artillery and other long range weapons. [5]

The locating and precision strike system PLSS is to be found in the endowment of the main NATO armies, having the following characteristics:

- it acts on an area of 500 x 500 km and at 150 km distance from the contact alignment;

- it can guide simultaneously 15 striking means, from which 5 on the final trajectory, with a guiding error of approximately 10 m;

- it ensures a striking precision with non-guided bombs of 25 – 50 m.

The AXE system from the endowment of the modern NATO armies in the TABAS, CAM-40 AND BOSS versions is used for striking airdromes from the operative and strategic enemy depth the command posts of the military structures.

The JSAK system is to be found in the endowment of the modern NATO armies, especially at the tactical and operative echelons and ensure the target acquisition, location and neutralization for ground uncovered targets up to a distance of 300 – 400 km.

This system is a newer version of the ASSAULT – BREAKER system and, in the anti-tank version, each rocket must ensure the neutralization of the uncovered armored tanks, belonging to at least a company.

The rockets are attached at the F.16, F 111 and B52 aircrafts and have a range of 180 - 200 km, which allows them to strike any objective located within the action range of a operative level force.

The WILD – WEASEL system ensures the striking of radiolocation stations of the artillery and air defense artillery, especially in the area where the command posts are established.

The anti-radiolocation rockets have a range of 80 -100 km. When they are launched from high altitudes, their range is of 20 - 40 km. When they are launched from lower altitudes, there are provided with passive guidance ends, of the single impulse type, and have a range of destruction of 15 – 25 m.

The WAAM system is based on using the aircrafts that support the troops, transport and spread antitank ammunition over the enemy tanks situated in the enemy depth, at distances of 50 - 300 km.

The HAMMER system destroys/neutralizes the uncovered enemy tanks, situated in the enemy depth up to a distance of 20 -40 km, by means of the guided reactive projectiles launchers from the ground or from the armored aircrafts and helicopters.

The BOSS system provides the striking of airdromes, railway nodes, complex fortification systems, uncovered armored tanks, the launching positions for rockets or the firing positions for artillery, within a distance of up to 750 km.

The WASP system provides the striking of uncovered armored tanks from the enemy depth, up to distance of 50 - 300 km or even more.

3 CONCLUSIONS

The technology overdevelopment from the military field constitutes the preoccupation of all modern armies. These have developed discouraging theories and have invested huge amounts of money to support these theories. On the one hand they have improved their classical striking means and systems and on the other they developed new efficient striking means and systems with the help of which they are able to conduct ample military actions in the ground, aerial, naval and space, practically annihilating the known geographical limits of the war or armed conflict.

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THE EQUATIONS GOVERNING THE RESPONSE OF A SUBMERGED SUBMARINE TO AN UNDERWATER GAS BUBBLE

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***Abstract**: In this paper it will be studied the effect of the underwater explosion on submerged submarines. A submarine will be simplified as free-free beams made from rigid perfectly plastic material. A detailed fluid structure interaction is analytically studied to obtain the equation governing the fluid force per unit length of the beam and the fluid - beam interaction equation. The time history of a bubble radius and explosion magnitude is graphically shown.*

***Keywords:** submarine, gas, bubble, equation.*

1 UNDERWATER SHOCK PHENOMENA

An underwater explosion [3, 4] interacts with the surrounding fluid in two different phases. The first phase is a transient shock wave, with a rapid rise in the fluid velocity, and large inertial loading. The peak pressure of this phase is very high, but it extremely short duration. The second phase is a radial pulsation of the gas bubble. This phase is characterized by lower peak pressure and much longer duration.

In underwater explosion, we must consider both types of loads: shock wave and bubble pulse, but because of their quite different time scales, they may be separately analyzed.

Basically, a shock wave induces local damages but a bubble can lead to global damages. The present paper is concerned with the damage pattern produced by the bubble pulse. The pulse duration of an underwater explosion bubble is close to the lower frequency vibration modes of a typical ship or submarine. Thus, the induced vibration can easily be so severe that the hull girder fails and a plastic hinge is formed at the point of failure.

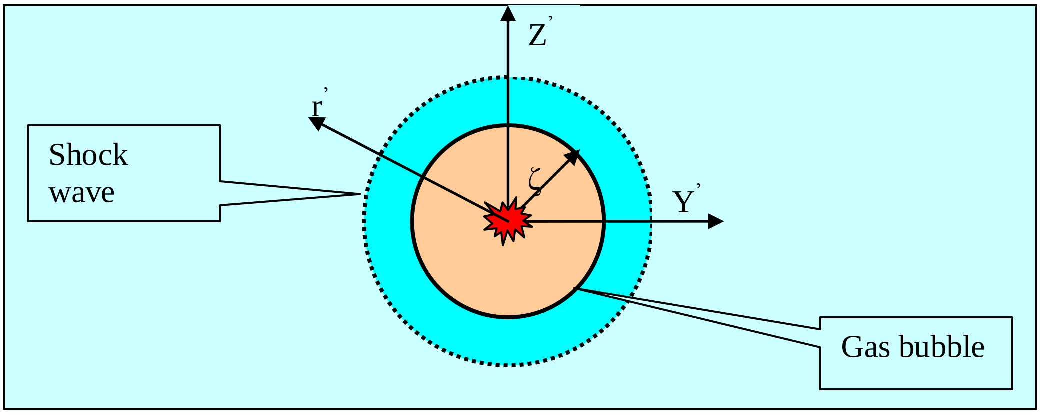

Fig. 1: O'x'y'z' coordinate systems with the origin located at the bubble centre

2 PROBLEM FORMULATION AND INITIAL CONDITIONS

The effect of the underwater explosion on submerged submarine [2, 3] will be studied in this paper, and to facilitate the derivation and to simplify the problem as much as possible without losing essential features we consider:

1. the submarine is considered a uniform free-free beam of circular section, subjected to a pulsating gas bubble only as shown in figure 4.

2. the beam is slender, $\frac{R_c}{R_0} << 1$ and because $\varepsilon = \frac{R_C}{L} << 1$ resulting that a 3-dimensional flow can be locally approximated by a 2-dimensional flow.

3. the bubble radius and pressure at any time are ζ(t) and P(t), and the initial radius and pressure are ζ0 and P0.

4. the fluid is inviscid and incompressible.

5. the beam is much smaller than the distance from the bubble centre Rc/R0<<1

6. there exists a potential Φ satisfying the Laplacian equation Φ = φb + φp where:

- *φb denotes the potential purely produced by the bubble;*
- *φp denotes all other effects due to the presence of the beam.*

The main disturbance in the fluid is produced by the bubble: in D_b domain (near the bubble, and far away from the beam), $\varphi_b >> \varphi_p$ and in D_p domain (near the beam and far away from the bubble), φ_b is of same order as φ_p, i.e., $O(\varphi_b) = O(\varphi_p)$. The solution to potential Φ can then be found through solving the two potentials φ_p and φ_b.

3 BUBBLE DYNAMICS

We consider a *O'x'y'z'* coordinate systems with the origin located at the bubble centre as is shown in figure 1. In D_b domain, from 6th assumption $\Phi \approx \varphi_b(x',y',z'; t)$, and φ_b satisfies the Laplacian equation:

$$\nabla^2 \varphi_b = \frac{\partial^2 \varphi_b}{\partial^2 x'^2} + \frac{\partial^2 \varphi_b}{\partial^2 y'^2} + \frac{\partial^2 \varphi_b}{\partial^2 z'^2} = 0 \qquad (1)$$

and the boundary conditions on the bubble surface are:

$$\frac{\partial \varphi_b}{\partial t} = -\frac{P_g}{\rho_0} - \frac{1}{2}\left|\nabla \varphi_b\right|^2 - g \cdot d_0 \qquad \text{at } r' = \zeta_0 \qquad (2)$$

$$\frac{d\zeta}{dt} = \frac{\partial \varphi_b}{\partial r'} \qquad \text{at } r' = \zeta \qquad (3)$$

$$\left|\nabla \varphi_b\right| \to 0 \qquad \text{at infinity} \qquad (4)$$

P_g is the pressure inside the bubble, d_0 is the charge depth, g is the gravity acceleration, ρ_0 is the water density. The solution to equations (l) - (4) is a point source with time-dependent strength *q(t)* located at the centre of the bubble of the form:

$$\varphi_b = \frac{q(t)}{r'} \qquad (5)$$

Inside the bubble, the gas is assumed to be ideal and the pressure to be uniform:

$$\frac{P_g}{P_0} = \left(\frac{\zeta_0}{\zeta}\right)^{3\gamma} \quad \text{where } \gamma = 1{,}4 \qquad (6)$$

Substituting eqs (5) and (6) into eqs. (2) and (3), we obtain:

$$\frac{dq}{dt} = -\frac{P_0 \cdot \zeta}{\rho_0}\left(\frac{\zeta_0}{\zeta}\right)^{3\gamma} - \frac{q^2}{2\zeta^3} + g \cdot \zeta \cdot d_0 \qquad (7)$$

$$\frac{d\varsigma}{dt} = -\frac{q}{\zeta^2} \qquad (8)$$

$$q(t) = -\zeta^2 \cdot \dot{\zeta} \qquad (9)$$

The solutions of eqs. (7) and (8) can be numerically integrated using Runge-Kutta method once the initial conditions are given. Its solutions are two functions ***q(t)*** and ***ζ(t)***, and an example is given in Fig.2.

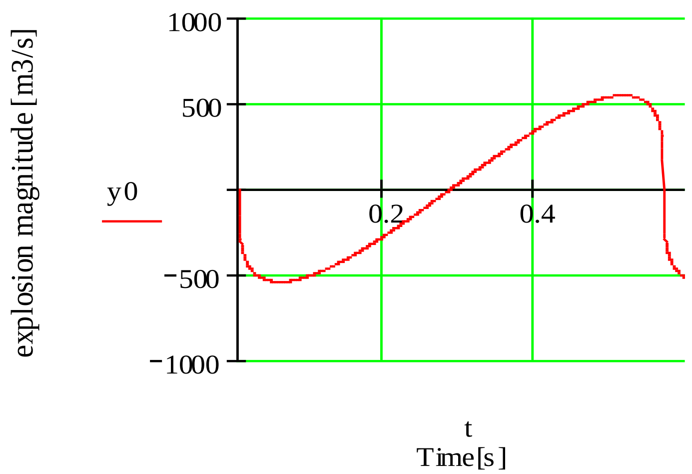

Fig.2.a: Time histories of explosion magnitude

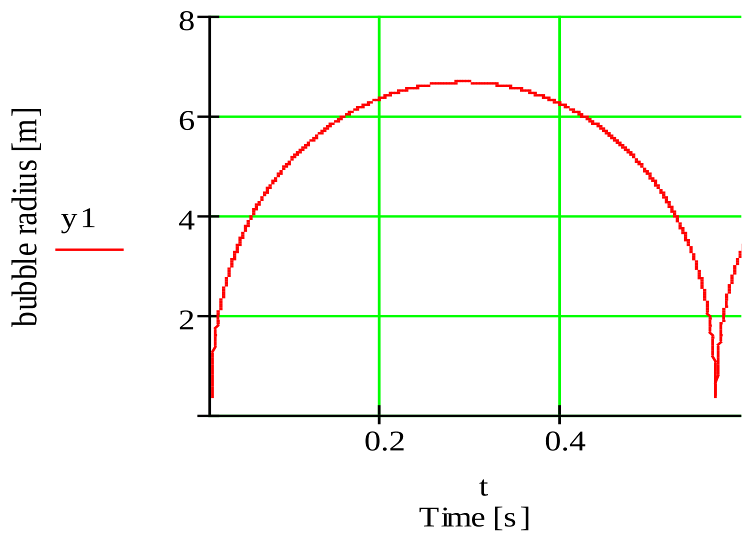

Fig.2.b: Time histories of bubble radius

4 A SUBMERGED FREE-FREE BEAM OF CIRCULAR SECTION SUBJECTED TO A PULSATING GAS BUBBLE

A submerged submarine is an example of a submerged free-free beam as its buoyancy and gravity cancel each other

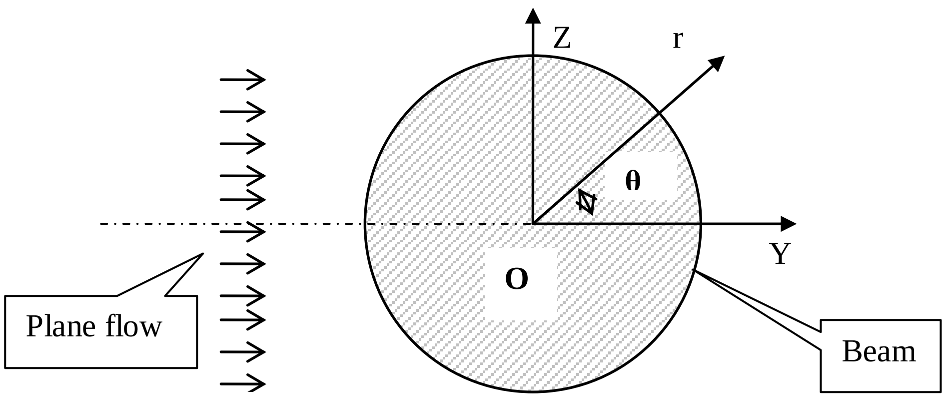

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Fig. 3. Fluid-structure interaction and Oxyz coordinate systems with the origin located at the beam centre

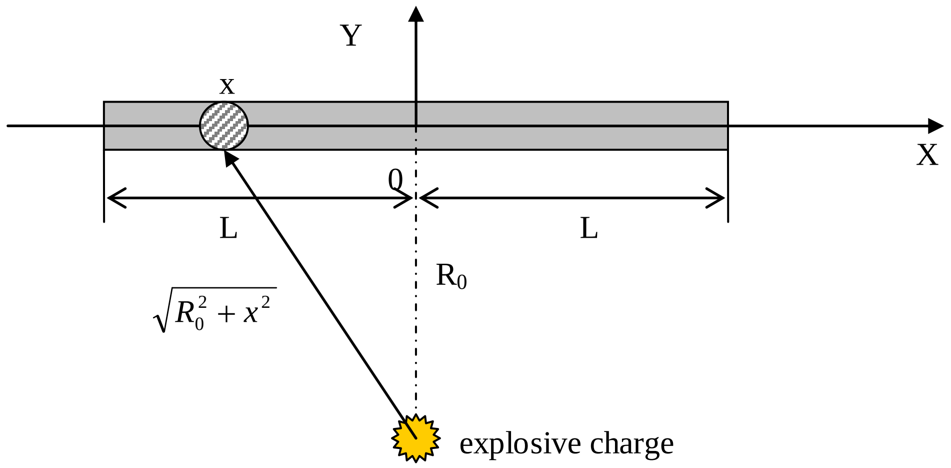

Fig. 4 A free- free beam subjected to the gas bubble

In figure 4, R_C is the radius of the beam, $2L$ is the beam length with free-free supports at both ends, and R_0 is the stand-off distance.

4.1 Fluid Force On The Beam

The deflection of the beam, including rigid body motion and plastic deformation, is described [2] by w(x,t), and the fluid force acting on the beam per unit length is f(x,t).

Introducing the following nondimensional equations in domain Dp,

$$\bar{x} = \frac{x}{L}; \bar{y} = \frac{y}{R_c}; \bar{z} = \frac{z}{R_c} \tag{10}$$

We have: $$\frac{\partial \Phi}{\partial x} = \frac{1}{L}\frac{\partial \Phi}{\partial \bar{x}}; \frac{\partial \Phi}{\partial y} = \frac{1}{R_c}\frac{\partial \Phi}{\partial \bar{y}}; \frac{\partial \Phi}{\partial z} = \frac{1}{R_c}\frac{\partial \Phi}{\partial \bar{z}} \tag{11}$$

Because $\varepsilon = \frac{R_C}{L} << 1$ and the derivatives with respect to the nondimensional quantities are of same order, the above equations indicate that:

$$\frac{\partial \Phi}{\partial x} << \left(\frac{\partial \Phi}{\partial y}, \frac{\partial \Phi}{\partial z}\right), and \frac{\partial^2 \Phi}{\partial x^2} << \left(\frac{\partial^2 \Phi}{\partial y^2}, \frac{\partial^2 \Phi}{\partial z^2}\right) \tag{12}$$

Moreover, from 2nd assumption we conclude that *(y,z)<<R_0* in the domain D_p. In domain D_p, φ_p takes the following asymptotic form [2]:

$$\varphi_b \approx \frac{q}{\sqrt{R_0^2 + x^2}}\left(1 - \frac{yR_0}{R_0^2 + x^2}\right) \text{and} \frac{\partial \varphi_b}{\partial y} \approx -\frac{qR_0}{(R_0^2 + x^2)^{\frac{3}{2}}} = v \tag{13}$$

We obtain:

$$\nabla^2\Phi = \frac{\partial^2\Phi}{\partial y^2} + \frac{\partial^2\Phi}{\partial z^2} = 0 \text{ in } D_p;\ \frac{\partial\Phi}{\partial r} = \frac{\partial w}{\partial t}\cos\theta \text{ at } r=R_c;\ \frac{\partial\Phi}{\partial r} = 0 \text{ at infinity} \tag{14}$$

Because φ_b is known, the above equations uniquely determine φ_p. We may further write the total potential $\Phi = \varphi_b + \varphi_D + \varphi_R$, where:

- $\boldsymbol{\varphi_D}$ is the diffraction flow field induced by the beam free of any deformations satisfying:

$\nabla^2\varphi_D = 0$ in D_p; $\frac{\partial\varphi_D}{\partial r} = \frac{\partial\varphi_b}{\partial t} = -v\cdot\cos\theta$ at $r = R_c$; $\left|\nabla\varphi_D\right| \to 0$ at infinity, with the solution:

$$\varphi_D = v\frac{R_c^2}{r}\cos\theta \tag{15}$$

- $\boldsymbol{\varphi_R}$ is the radiation potential produced purely by the deflection of the beam, satisfying:

$\nabla^2\varphi_R = 0$ in D_p; $\frac{\partial\varphi_R}{\partial r} = \frac{\partial w}{\partial t}\cos\theta$ at $r = R_c$; $\left|\nabla\varphi_R\right| \to 0$ at infinity, with the solution:

$$\varphi_R = \frac{\partial w(x,t)}{\partial t}\frac{R_c^2}{r}\cos\theta \tag{16}$$

We may use (because $\frac{R_c}{R_0} << 1$) the linearized Bernoulli's equation $P = -\rho_0\frac{\partial\Phi}{\partial t}$ to find the pressure on the beam surface. Integrating this equation on the beam surface and substituting eqs. (13), (15) and (16) it is obtained the fluid force per unit length:

$$f(x,t) = \pi\rho_0 R_C^2\dot{v} + \pi\rho_0 R_C^2\dot{v} - \pi\rho_0 R_C^2\frac{\partial^2 w}{\partial t^2} = 2m_a\dot{v} - m_a\frac{\partial^2 w}{\partial t^2} \tag{17}$$

- The first term is the bubble-induced force without diffraction effect considered.
- The second term is caused by the diffraction effect.
- The third term is the radiation force caused by the beam motion, and the added mass of a circular section in water is $m_a = \pi\rho_0 R_C^2$.

Equation (17) can be generalized to beams of any cross sections shapes and has the form [2]:

$$f(x,t) = \rho_0 A_S\dot{v} + m_a\dot{v} - m_a\frac{\partial^2 w}{\partial t^2} = h\dot{v} - m_a\frac{\partial^2 w}{\partial t^2} \tag{18}$$

Where A_S is the cross section area of the considered beam.

4.2 Fluid-Beam Interaction Equations

The transverse force equilibrium and moment equilibrium equations for a straight beam are:

$$\frac{\partial Q}{\partial x} = -f(x,t) + m_0\frac{\partial^2 w}{\partial t^2} \text{ and } Q = \frac{\partial M}{\partial x} \tag{19}$$

where M and Q denote the bending moment and shear force, respectively, and m_0 is the mass density per unit length of the beam.

The influence of rotational inertia, gravitational effects and transverse shear effects are neglected, while the strains are assumed to remain small. Substituting eq. (18) into eq. (19) gives:

$$\frac{\partial Q}{\partial x} = -h\dot{v} + \left(m_a + m_0\right)\frac{\partial^2 w}{\partial t^2} = g\left(x\right)\cdot\dot{q}\left(t\right) + m\frac{\partial^2 w}{\partial t^2} \qquad (20)$$

where: $g\left(x\right) = \frac{hR_0}{\left(R_0^2 + x^2\right)^{2/3}}$ and $\dot{q}\left(t\right) = -\frac{d}{dt}\left(R^2\dot{\varsigma}\right)$ (21)

are obtained from Eq. (13) $m = m_0 + m_a$ is the equivalent mass including hydrodynamic effects.

The boundary conditions at the ends x = — L and x = L of a beam of length 2L are Q = 0 and M = 0.

The axial force is zero at the beam end and remains small everywhere else in the beam. Therefore, the present classical beam equations are believed to be valid in the range of moderately large deflections [2].

5 CONCLUSIONS

In this paper, a detailed fluid structure interaction analysis was given to obtain the equation governing the fluid force per unit length of the beam representing a submerged submarine subject to an underwater bubble, and the fluid - beam interaction equation.

The bubble radius decreases from its maximum value at the beginning to its minimum. This is the process referred to as bubble collapse. During the process, the bubble radius decreases, but the pressure inside the bubble increases quickly. Thus the force acting on the mid-span of the beam increases as the bubble radius decreases.

Note that most part of the force during the bubble collapsing is negative because the bubble contracts and surrounding water flows towards the bubble. After reaching its minimum radius, the pressure inside the bubble is so large that the bubble rebounds. The radius then increases with time.

During the rebounding process, the force acting on the beam decreases quickly to values below zero. Thus the force acting on the beam is characterized by a narrow pulse of high amplitude superposed on a slowly-varying load of low amplitude.

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ON A TRANSPORTATION PROBLEM TYPE

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Abstract: *This paper presents an algorithm for solving a special problem which distributes different types of ware from dealers to some customers such that each customer receives ware of the same type and an efficiency function is maximized.*

Keywords**:** *transport ,algoritm, ware.*

1 INTRODUCTION

Many decision problems are formulated as mathematical programs requiring the maximization or minimization of an objective function subject to several constraints. Such programs often have special structure. In linear programming, the nonzero elements of the constraint matrix may appear in diagonal blocks, except for relatively few rows or columns. Nonlinear programs may become linear if certain variables are assigned fixed values, or the functions involved may be additively separable. By developing specialized solution algorithms to take advantage of this structure, significant gains in computational efficiency and reductions in computer memory requirements may be achieved [6], [8], [9].

There are practical problems which deal with the optimal distribution of quantities from some dealers to some customers. Such problems are known as “transportation problems” and they are solved for example in [2], [3], [4], [10]. If to these problems some supplementary conditions are required, then the basic algorithms must be adequately modified [1], [5]. In what follows, we demand that any customer receives only ware of the same type, that means form just one dealer.

2 PROBLEM STATEMENT AND SOME RESULTS

Let us make the following notations:

- m – the number of ware types (of dealers);
- n – the number of customers;
- a_i – the quantity of avaible ware of type i, $1 \leq i \leq m$;
- b_j – the quantity of avaible ware of type j, $1 \leq j \leq m$;
- x_{ij} – the quantity of ware of type i distributed to customer j;
- c_{ij} – the unitary efficiency of ware i at customer j.

The problem is to ascertain a distribution of ware from dealers to customers such that the efficiency is maximized and each customer receives only one type of ware.

In order that the distribution of the ware to customers may always be possible, we associate some variables α_j to the required quantities b_j. Further on, we associate to each x_{ij} a Boolean variable p_{ij} through which we impose the condition that every customer receives ware from just one dealer.

The problem is stated as follows:

$$\text{maximize } \left\{ \sum_{\mathrm{j}=1}^{\mathrm{n}} \left(\sum_{i=1}^{m} c_{ij} p_{ij} x_{ij} + \alpha_j b_j \right) \right\} \tag{PP}$$

subject to:

$$\sum_{j=1}^{n} p_{ij} x_{ij} \le a_i \qquad 1 \le i \le m \tag{2.1}$$

$$\sum_{i=1}^{m} p_{ij} x_{ij} \ge \alpha_j b_j \qquad 1 \le j \le n \tag{2.2}$$

$$\sum_{i=1}^{m} p_{ij} = 1, \qquad 1 \le j \le n \ ; \quad p_{ij} \in \ 0,1 \tag{2.3}$$

$$0 \le \alpha_j \le 1, \qquad 1 \le j \le n \tag{2.4}$$

$$x_{ij} \ge 0, \qquad 1 \le i \le m \ , \quad 1 \le j \le n \tag{2.5}$$

Remark: The constraint (2.3) makes that customer *j* receives in condition of (2.2) only ware of one type, i.e. $p_{ij} = 1$ for just one value of *j*.

Proposition 2. 1. If $a_i > 0 \ \ 1 \le i \le m$ and $b_j > 0 \ \ 1 \le j \le n$, then there exists $p_{ij} \in \ 0,1$ and $\alpha_j \in \ 0,1$ such that problem (PP) has always a feasible solution.

Proof. Let us first suppose that $\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j = S > 0$. Then the values $y_{ij} = \dfrac{a_i b_j}{S} \ge 0$ are a solution of the system:

$$\begin{cases} \sum_{j=1}^{n} y_{ij} = a_i, & 1 \le i \le m \\ \sum_{i=1}^{m} y_{ij} = b_j, & 1 \le j \le n \end{cases}$$

Now we define $p_{ij} = \begin{cases} 1 & \text{for } i = 1 \text{ and } 1 \le j \le n, \\ 0 & \text{for } 2 \le i \le m \text{ and } 1 \le j \le n \end{cases}$ and

$\alpha_j = 1 - \dfrac{1}{b_j} \sum_{i=2}^{m} y_{ij}, \ \ 1 \le j \le n$. Then a feasible solution to problem (PP) is given by:

$x_{ij} = \begin{cases} y_{ij} & \text{for } i = 1 \text{ and } 1 \le j \le n, \\ 0 & \text{for } 2 \le i \le m \text{ and } 1 \le j \le n \end{cases}$ which trivially verifies (2.1) – (2.5). For example, condition (2.2) becomes: $\sum_{i=1}^{m} p_{ij} x_{ij} = x_{1j} = y_{1j} = b_j - \sum_{i=2}^{m} y_{ij} = \alpha_j b_j$.

If $\sum_{i=1}^{m} a_i \ne \sum_{j=1}^{n} b_j$, then we can introduce an adequate slack quantity $b_{n+1} > 0$ or $a_{m+1} > 0$ to obtain the above equality condition. Finally, from the corresponding solution x_{ij} we drop the suitable slack variables so that the remainder constitutes a feasible solution of problem (PP).

This result outlines the fact that the variables α_j are rather penalties which are used in (2.2) to make a solution feasible and shows why the term $\alpha_j b_j$ appears in the objective function.

In the following we suppose that $a_i \ge 0 \ \ 1 \le i \le m$ and $b_j \ge 0 \ \ 1 \le j \le n$, and let us denote the index sets: $I := \ 1, 2, ..., m$ and $J := \ 1, 2, ..., n$.

Proposition 2.2. The problem:

$$\text{maximize } \left\{ \sum_{j \in J} \left(\sum_{i \in I} c_{ij} y_{ij} + \alpha_j b_j \right) \right\} \tag{P1}$$

subject to:

$$\sum_{j \in J} y_{ij} \le a_i, \quad i \in I \tag{2.6}$$

$$\sum_{i \in I} y_{ij} \ge \alpha_j b_j, \quad j \in J \tag{2.7}$$

$$0 \le \alpha_j \le 1, \quad j \in J \tag{2.8}$$

$$y_{ij} \ge 0, \quad i, j \ \in I \times J \tag{2.9}$$

has always an optimal solution.

Proof. If $\sum_{j \in J} b_j \le \sum_{i \in I} a_i$, we take $\alpha_j = 1, \ j \in J$, and (P1) becomes a transportation problem which has an optimal solution [7], [10].

If $\sum_{j \in J} b_j > \sum_{i \in I} a_i$, then we introduce a slack quantity a_{m+1} such that $\sum_{j \in J} b_j = \sum_{i \in I} a_i + a_{m+1}$, and we define $c_{m+1, j} = 0, \ j \in J$. According to this, the dimension of (P1) increases with the slack variables $y_{m+1, j}$, $j \in J$.

In this way, problem (P1) with $\alpha_j = 1, \ j \in J$, becomes an augmented transportation problem, which has an optimal solution $\bar{y}_{ij} \ge 0, \ \ i, j \ \in \ I \bigcup \ m+1 \ \ \times J$ that satisfies the conditions:

$$\sum_{j\in J}\bar{y}_{ij} = a_i, \quad i\in I \text{ and } \sum_{j\in J}\bar{y}_{m+1,j} = a_{m+1}$$
$$\sum_{i\in I}\bar{y}_{ij} = b_j - \bar{y}_{m+1,j}, \quad \text{where } 0\le \bar{y}_{m+1,j}\le b_j, \ j\in J$$

Now, we define: $\bar{\alpha}_j = \begin{cases} 1-\dfrac{\bar{y}_{m+1,j}}{b_j}, & \text{if } b_j\ne 0 \\ 1, & \text{if } b_j = 0 \end{cases}$, $j\in J$, and it follows obviously that $0\le\bar{\alpha}_j\le 1$ for all $j\in J$, and:

$$\sum_{j\in J}\bar{\alpha}_j b_j = \sum_{j\in J}\left(b_j - \bar{y}_{m+1,j}\right) = \sum_{j\in J} b_j - a_{m+1} = \sum_{i\in I} a_i$$

But from (2.6) and (2.7) we get: $\sum_{j\in J}\alpha_j b_j \le \sum_{i\in I} a_i$, so that:

$$\max_{\alpha}\sum_{j\in J}\alpha_j b_j = \sum_{i\in I} a_i$$

and this maximum is obtained for $\bar{\alpha}_j$, $j\in J$.

To complete the proof we notice that for any α_j, $0\le\alpha_j\le\bar{\alpha}_j$ and any feasible solution y_{ij} that satisfies (2.6), (2.7) and (2.9) we have:

$$\sum_{j\in J}\left(\sum_{i\in I} c_{ij}y_{ij} + \alpha_j b_j\right) \le \sum_{j\in J}\left(\sum_{i\in I} c_{ij}\bar{y}_{ij} + \bar{\alpha}_j b_j\right)$$

3 THE ALGORITHM

To obtain a solution to problem (PP) we can use that of problem (P1) and consider $y_{ij} = p_{ij}x_{ij}$. But condition (2.3) demands that in the solution matrix $\left(y_{ij}\right)$ there be only one element different from zero in each column. So we are interested in such an element which is dominant in $\sum_{i\in I} c_{ij}y_{ij}$. Accordingly, for each $j\in J$, we define:

$$p_{ij} = \begin{cases} 1 & \text{for just one } c_{ij}y_{ij} = \max_{s\in I}\left(c_{sj}y_{sj}\right) > 0 \\ 0 & \text{otherwise} \end{cases}$$

and let $M = \left\{ (i,j) \in I\times J \mid p_{ij} = 1 \right\}$. We notice that for every $j\in J$ there exists one $i\in I$ such that $(i,j)\in M$. Let us denote:

$$J_i = \left\{ j\in J \mid (i,j)\in M \right\}$$

Obviously, it may be possible that some of the index sets J_i are empty, but they are disjoint and $J = \bigcup_{i\in I} J_i$.

In order that condition (2.2) will be satisfied, we redefine:

$$\alpha_j = \frac{1}{b_j} \sum_{i \in I} p_{ij} x_{ij} , \quad j \in J \tag{3.1}$$

The objective function becomes the value $\sum_{j \in J} \sum_{i \in I} \; c_{ij} + 1 \;\; p_{ij} x_{ij}$, which may be increased only if among conditions (2.1) there are some strictly satisfied; more precisely, if $I_2 \cup I_3 \neq \varnothing$, where $I = I_1 \cup I_2 \cup I_3$ and the partition of the index set I is defined as follows:

$$\sum_{j \in J} p_{ij} x_{ij} = a_i , \text{ for } i \in I_1$$

$$0 < \sum_{j \in J} p_{ij} x_{ij} < a_i , \text{ for } i \in I_2$$

$$0 = \sum_{j \in J} p_{ij} x_{ij} < a_i , \text{ for } i \in I_3$$

To do that, we consider for each $s \in I_1 \cup I_2$ the problem:

$$\text{maximize} \sum_{j \in J} \; c_{sj} + 1 \;\; p_{sj} x_{sj} \tag{P2}$$

subject to:

$$\sum_{j \in J} p_{sj} x_{sj} \leq a_s \tag{3.2}$$

$$0 \leq p_{sj} x_{sj} \leq b_j , \quad j \in J \tag{3.3}$$

Condition (3.3) follows from (2.4), (2.5) and (3.1). Due to condition (2.3), the problems (P2) are independent sub-problems of (PP), so that the solutions of (P2) must retrieve in that of (PP).

Owing to the choice of p_{ij} and the definition of the index sub-sets J_i, problem (P2) may be stated in a more convenient form: for $s \in I_1 \cup I_2$ and $J_s \neq \varnothing$,

$$\text{maximize} \sum_{j \in J} c_{sj} x_{sj} \tag{P3}$$

subject to:

$$\sum_{j \in J} x_{sj} \leq a_s$$

$$0 \leq x_{sj} \leq b_j , \quad j \in J$$

We retain the solution $\overline{x}_{sj}$ of all problems (P3) in the set

$$S = \;\; \overline{x}_{sj}, s, j \;\; \in \mathbf{R} \times I \times J \;\middle|\; \overline{x}_{sj} > 0$$

and define:

$$K = \;\; j \in J \;\middle|\; (\exists)\, s \in I_1 \cup I_2 \text{ such that } \overline{x}_{sj} = b_j \;\; .$$

Now, we make the following changes:

$$\text{the index set } J \text{ is replaced by } J \setminus K \tag{3.4}$$

the values a_i by $\begin{cases} a_i - \sum_{j\in K} \overline{x}_{ij} & \text{if } K \neq \varnothing \\ a_i - \sum_{j\in J_i} \overline{x}_{ij} & \text{if } K = \varnothing \end{cases}$ (3.5)

we redefine the index set $I = \{ i \mid a_i > 0 \}$ (3.6)

If the set $I \times J$ is empty, then *S* gives us the solution of the problem (PP). If the set $I \times J$ is not empty, then we consider a new problem (P1) which may be treated in the same way like before. The new values $\overline{x}_{sj}$ are added to, or they replace the old ones with the same indices (s, j) in the solution set *S*.

It is obvious that in each iteration of the algorithm, at least one of the index sets *I* or *J* has less elements than before, so that the algorithm ends after a finite number of steps.

The steps of the algorithm may be stated as follows:

Step 1. Define $I := \{1, 2, ..., m\}$, $J := \{1, 2, ..., n\}$ and $S = \varnothing$.

Step 2. Solve problem (P1) and define the sets M and J_i.

Step 3. Determine and solve the problems (P3).

Step 4. Add the new solution sets $\overline{x}_{ij}$ of problems (P3) to S and redefine the index set I and J according to (3.4), (3.5) and (3.6).

Step 5. If $I \times J = \varnothing$, then STOP. S gives the solution to (PP). If $I \times J \neq \varnothing$, then go to Step 2.

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DITA FOR E-LEARNING SYSTEMS

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Abstract*: The Darwin Information Typing Architecture (DITA) is an XML-based architecture for authoring, producing, and delivering technical information. DITA includes topics like: Task, Concept, Reference. In this paper we present some solutions regarding the DITA use for elearning.*

Keywords**:** *DITA, architecture, e-learing.*

1 E-LEARNING STANDARDS

SCORM (Sharable Content Object Reference Model)

The United States Department of Defense (DoD) and the White House Office of Science and Technology Policy (OSTP) were the initiators of the Advanced Distributed Learning Initiative (ADL) in November 1997. ADL's Sharable Content Object Reference Model (SCORM) is designed to create a framework for developing computer based and web-base learning systems.

Functional requirements for all SCORM-based e-learning environments:

Accessibility: The ability to locate and access instructional components from one remote location and deliver them to many other locations.

Adaptability: The ability to tailor instruction to individual and organizational needs.

Affordability: The ability to increase efficiency and productivity by reducing the time and costs involved in delivering instruction.

Durability: The ability to withstand technology evolution and changes without costly redesign, reconfiguration or recoding.

Interoperability: The ability to take instructional components developed in one location with one set of tools or platform and use them in another location with a different set of tools or platform.

Reusability: The flexibility to incorporate instructional components in multiple applications and contexts.

Reusable learning objects (RLO)

Reusable learning objects or RLOs is a joint effort of learning content designers at several companies, including Autodesk®, Oracle®, and Cisco®. According to author Peder Jacobsen, an RLO represents "a discrete reusable collection of content used to present and support a single learning objective". Using RLO's, you can create a pool of information objects and later use this item for other learning delivery contexts. RLO's have their advantages but do not provide a standard way to package and deliver the content to users.

2 DITA (DARWIN INFORMATION TYPING ARCHITECTURE)

The Darwin Information Typing Architecture (DITA) [2] is an XML-based architecture for authoring, producing, and delivering technical information. Any DITA document uses topics. A topic is a piece of information that has the following characteristics:

- answers one question(How do I…? What is...? etc.);
- it has a heading;
- it can stand alone;
- it makes sense in any context.

DITA includes topics like: Task, Concept, Reference.

- A Task topic describes how to accomplish a task. It displays a list of steps that the users must follow to produce a specified result.
- A Concept describes something. It contains definitions, rules and guidelines.
- A Reference topic offers details. It describes command syntax, programming instructions, reference material.

2.1Topic structure

In DITA all topics have the same structure:

- title;
- description;
- prolog;
- body.

Topic structures may have the following parts:
- Topic element

- Requires an *id* attribute;
- Contains all other elements

- Title
  - The subject of the topic
- Alternate titles
  - Titles specifically for use in navigation or search.
- Short description
  - A short description of the topic.
- Prolog
  - Contains various kinds of topic information, such as audience, product, and so on.
- Body
  - The actual topic content: paragraphs, lists, sections.
- Related links
  - Links to other topics
- Nested topics
  - Topics can be defined inside other topics

2.2 Concept structure

The concept structure [1] contains as the first element the <concept> element. The concept element has a standard structure as the one described above. It has <title>, <conbody>-the body of the concept topic, <titlealts>, <shortdesc>, <prolog>, <related links>.

<conbody> allows paragraphs, lists, elements, sections or examples.

Here is an example of a simple concept topic.

```
<concept id="concept">
 <title>Computer</title>
  <conbody>
   <p>A computer is an electronic device that processes
data</p>
    <example>
    <p>A computer is able to:</p>
    <ul>
     <li>Make calculations</li>
     <li>Connect to a network</li>
     <li>Process images</li>
     <li>Process texts</li>
    </ul>
   </example>
  </conbody>
</concept>
```

2.3 Task structure

The task structure [1] contains as the first element the <task> element. The task element has a standard structure as the one described in the concept element. It has <title>, <conbody>-the body of the concept topic, <titlealts>, <shortdesc>, <prolog>, <related links>. The <taskbody> element (the body element of the task topic) has the following elements:

- <prereq> - information needed before the task starts
- <context> - information needed for task completing
- <steps> - the necessary actions for a task to be accomplished
- <result> - the expected outcome of the task
- <example> - examples that illustrates the task
- <postreq> - the necessary actions that a user must initiate after the task completion

Here's an example of a task topic.

```
<task id="copy file">
 <title> File copying </title>
  <taskbody>
   <context>Each day you need to copy files for
backup</context>
    <steps>
     <step><cmd> Select the file by clicking it</cmd></step>
     <step><cmd> Right click, select Copy</cmd></step>
     <step><cmd> Select destination folder</cmd></step>
     <step><cmd> Right click, select Paste </cmd></step>
    </steps>
    <result>You now have your file copy!</result>
  </taskbody>
</task>
```

2.4 Reference structure

The <reference> [1] element additional pieces of information for the concept and task topics. Reference topics have the same structure as concept or task. In addition, reference topics have elements that describe the body of the reference.

The body of the reference is called <refbody> and contains the following elements:

- <section> - The <section> element divides the reference topic into smaller divisions. A section may have an optional title.
- <refsyn> - Contains syntax or signature content (for example, a command-line utility's calling syntax, or an API's signature)
- <example> - examples that illustrates the reference
- <table> - Organizes information according into a tables
- <properties> - Lists properties and their types, values, and descriptions.

2.5 Domains

A DITA domain defines a set of vocabulary elements that can be used regardless of topic type. The elements in a domain are defined in a domain module which can be integrated with a topic type to make the domain elements available within the topic type structure. Currently the following domains are provided [1]:

Typographic	For highlighting when the appropriate semantic element doesn't exist yet
Programming	For describing programming and programming languages
Software	For describing software
User interfaces	For describing user interfaces
Utilities	For providing imagemaps and other useful structures

DITA is an emerging standard that provides an outstanding platform to promote information interchange, in an orderly fashion, within an enterprise or with other organizations.

DITA provides several good methodologies for managing an "information supply chain" where supplier and consumer can easily interchange topics.

DITA provides an excellent infrastructure for managing information at a topic level, getting away from document hierarchies that in the past have added complexities to interchange. The DITA architecture, a related DTD and a W3C-Schema was originally developed by IBM. DITA is now an OASIS standard.

3 IBM DITA STRUCTURE FOR E-LEARNING

DITA provides a infrastructure for developing a content model for learning. The DITA specialization architecture provides a built-in method to extend DITA to support new content elearning elements.

IBM developed the following DITA extensions that support learning content [4]:

- New topic types – will support learning-specific topic types such as lesson overviews, objectives, summaries, exercises, assessment content.
- A new content domain – will support content vocabularies that are used across the DITA topic types for learning support.
- A new map domain DITA that collects and organize references to DITA learning topics to indicate the relationships among the topics and delivery as a learning course.
- A DITA process model for designing, writing, and delivering learning content.

DITA topic types for learning

DITA topic types for learning are contained in a learningbase type. These new topics are: learningOverview, learningTopic, learning Summary, learning Practice, learning Assesment.

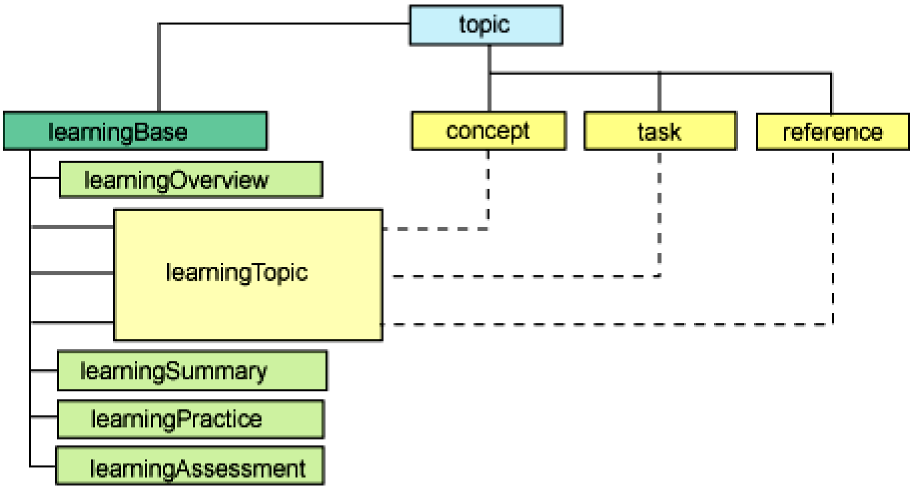

Fig. 1. IBM DITA topic types for elearning [4]

The learning Topic type provides a container for DITA concept, task, and reference topic types.

4 USING DITA FOR PUBLISHING PROCEDURES MANUALS

Procedures manuals are a collection of task to be accomplished by the emploees of a company. Structuring a procedure manual has become an easy task using DITA. Taking advantage of the DITA specification, the manuals can be structured using DITA topics: Task, Concept or Reference. On the other hand, the manuals may be print for different audience.

In this section we are trying to design a DITA structure for the procedures manual of a hypermarket.

The DITA Structure of a Procedure Manual for Goods Receiving in a Romanian Supermarket

Creating Content

We used the XMLMind editor for creating the DITA procedures manual. XMLMind is a free XML editor which has a free DITA plug-in that provides user-friendly templates for standard DITA topic types an for DITA map files.

First, we created the concepts, then the tasks and the references. Each concept or task or reference is an xml file. The topics that we have created are:

Topics

Concepts

- Receptie marfa
- Comanda
- NIR

Task

- Lansare comanda
- Verificare existența comandă
- Verificarea mărfii la recepție

Reference

- Starea comenzii
- Inregistrarea receptiei
- Document privind returul/refuzul de marfa

Audience

- Director magazin
- Sef departament
- Category manager
- Sef raion
- Operator calculator
- Lucrator comercial

After creating these topics we have created the ditamap file. Ditamap is a map file that puts together all the files into a single document. The map file describes the sequence and hierarchy of the topics and sometimes the relationship between them. There can be created as many map files as one need. For example, one map file for a PDF output and one map file for the HTML output.

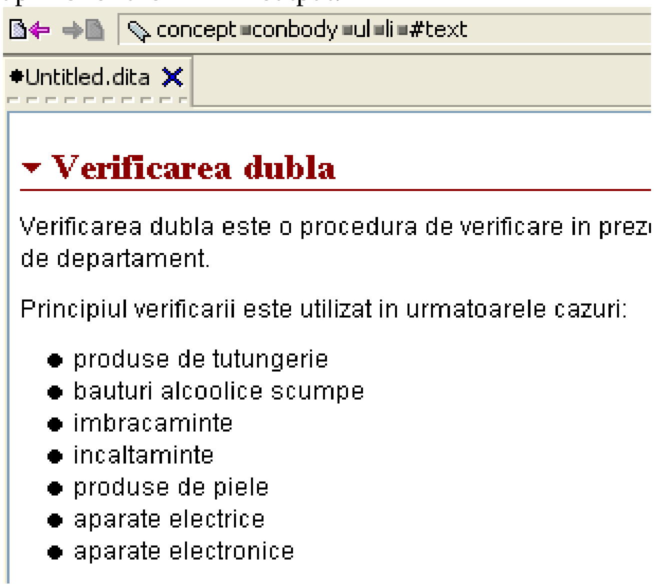

Fig. 2. Creating a DITA Concept with XMLMind

An important step in creating DITA documents is conditional processing or filtering logic [3]. To exclude topics that have certain attributes from the output we have created a ditaval file using prop elements with attributes att, val, action. For example:

```
<prop action="exclude" att="audience" val="director departament">
```

Will exclude all topics that are related with the “director departament” duties.

The final step is creating output. The Dita Open Toolkit [3] can build output in HTML format or PDF format. The output can be customized using CSS styles or by modifying XSL templates.

5 CONCLUSION

XML is fast becoming “the language” for information interchange and describing relationships. There is XML for biology, XML for chemistry, XML for rights management, XML for finance, XML for business rules, XML for publishing, etc. In this paper we tried to present some of the latest applications of XML. We have presented DITA as a new standard for writing documentation and some implications of DITA in the e-learning process.

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ABOUT A CHARACTERIZATION OF ISOFIELDS AND THEIR ISODUALS

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Abstract: *Because of certain physical motivations, Ruggero Maria Santilli introduced in 1980 at the International Conference on Differential Geometric Methods in Physics a new class of fields today known as isofields. In 1985 Santilli introduced a new antiautomorphic conjugation called isoduality which yields the conjugate class of isodual isofields. In this paper we present the most general possible formulation of isofields and their isoduals and after that, generalized structurable algebras.*

***Keywords*:** *isofields, isoduals.*

1 ISOFIELDS AND THEIR ISODUALS–DEFINITION

The isofields and their isodual form a new branch of number theory called theory of isonumbers, which basically refers to the elements at the foundation of the so-called Lie-Santilli isosymetries, which are nonlinear and nonlocal.

Definition1.1 [7] - [9]: Let F be a field of characteristic zero with elements a, b, c,… operations "+","×" and related units 0 and 1. An *isofield* $\underline{F}$ is the same set F with the same sum "+" and additive unit 0, but equipped with the new multiplication" $\underline{\times}$ "
$a \underline{\times} b := a \times U \times b, U = fixed, \forall a, b \in F$ where U is an invertible element generally outside the original field F called isotopic element, and the corresponding new unit:
$\underline{1}\,\underline{\times}\, a = a\,\underline{\times}\,\underline{1} = a$, $\underline{1} = U^{-1}$, called multiplication isounit, under the condition that all axioms for $\underline{F}$ to be a field are verified.

Note that isofields $\underline{F}$ are fields as necessary for the lifting $F \Rightarrow \underline{F}$ to be an isotopy. Note also that each given conventional field F admits an infinite family of isotopies $\underline{F}$ characterized by the infinitely possible isotopic elements U (or isounits 1).

Finally, note that the isotopic element U (or isounit $\underline{1}$) is generally outside the original field F.

It is obvious that the generalization of multiplicative unit and fields implies the isotopic generalizations of all mathematical methods used in physics, such as: vector spaces, metric or universal enveloping associative algebras, Lie algebras, Lie groups, representation theory and Riemannian geometries.

The isotopies of real number are given by

$$\underline{R} = \{n/(+,\underline{\times});0,\underline{1};\underline{\times} = \times U\times, \underline{1} = U^{-1}, n \in R\}$$

and, in general, the isofields used in physical applications are

$$\underline{F} = \{\underline{n}/(+,\underline{\times});0,\underline{1};\underline{n} = n\underline{1}, \underline{\times} = \times U; \underline{1} = U^{-1}, n \in F\}$$

in which all original elements a$\in$F are lifted via the one-to-one isotopy a$\Rightarrow$$\underline{a}$ = a$\underline{1}$

Definition 1.2 [7] – [9]: Let $\underline{F} = \{n/(+,\underline{\times});0,\underline{1};\underline{1} = U^{-1}, n \in F\}$, be an isofield as in Definition 1.1. An *isodual isofield* $\underline{F}^d$ is the structure

$$\underline{F}^d = \{n^d/(+,\underline{\times}^d);0,\underline{1}^d;\underline{\times}^d = \times U^d\times; U^d = -U, \underline{1}^d = -\underline{1}\}$$

$$n^d = \{n^c 1^d; n^c = \overline{n} \in F^c\}$$

where F^c is the conventional conjugation of F.

The above concept of isoduality can be first applied to convenient fields. In fact, the isodual C^d of the complex number C is given by

$$C^d = \{c^d/(+,\underline{\times}^d);0,1^d;\times^d = -\times; 1^d = -1, c^d = c^d 1^d = -\underline{c}, \underline{c} \in C^c\}$$

where $\underline{c}$ is the usual complex conjugation. Thus given a complex number

c = a + ib$\in$C, its isodual is given by $c^d = -\underline{c} = -a - i^c b = -a + ib \in C^c$, the product of a complex number $(\neq 0)$ by its isodual is negative definite, $\left|c^d\right| = -(a^2 + b^2)$.

The construct of the above notion can be illustrated via the following.

Definition 1.3 [8]: Let F be a field with element a, b, c,…, the operation of addition and multiplication $(+,\times)$ and the corresponding additive unit 0 and multiplication 1. the *isofield* $\underline{F}$ or "*isotopic images*" $\underline{F}$ of F are given by sets of elements $\underline{a}$, $\underline{b}$, $\underline{c}$, …, characterized by all infinitely possible, one-to-one and invertible maps a$\rightarrow$$\underline{a}$ of the original elements a$\in$F equipped with the conventional sum +, a new operation $\underline{\times}$ called isomultiplication and a new unit, called multiplicative isounit $\underline{1}$, generally outside the original set F, which are such to verify all axioms for $\underline{F}$ to fields, i.e.:

1) Axioms of isotopic addition (isoaddition).

1.1) The set $\underline{F}$ is closed under addition, i.e. for all $\underline{a}$, $\underline{b}$ $\in \underline{F}$, we have $\underline{a}+\underline{b} \in \underline{F}$;

1.2) For all $\underline{a}$, $\underline{b}$, $\underline{c}$, $\in \underline{F}$, we have the following "*associative addition law*"

$$\underline{a} + (\underline{b} + \underline{c}) = (\underline{a} + \underline{b}) + \underline{c};$$

1.3) There is an element 0, call "*additive unit*", such that for all elements $\underline{a} \in \underline{F}$

$$\underline{a} + 0 = 0 + \underline{a} = \underline{a};$$

1.4) For each element $\underline{a} \in \underline{F}$, there is an element $-\underline{a} \in \underline{F}$, called the "opposite *of* $\underline{a}$", which is such that

1.5)

$$\underline{a} + (-\underline{a}) = 0;$$

2) Axioms of is multiplication.

2.1) The set $\underline{F}$ is closed under isomultiplication, i.e., for all $\underline{a}$ and $\underline{b} \in \underline{F}$ we have $\underline{a} \underline{\times} \underline{b} \in \underline{F}$;

2.2) All elements $\underline{a}$, $\underline{b}$, $\underline{c} \in F$ verify the following "*associative multiplication law*"

$$\underline{a} \underline{\times} (\underline{b} \underline{\times} \underline{c}) = (\underline{a} \underline{\times} \underline{b}) \underline{\times} \underline{c};$$

2.3) There exists a quantity $\underline{1}$, called the "*multiplicative isounite*" which is such that, for all elements $\underline{a} \in \underline{F}$,

$$\underline{a} \underline{\times} \underline{1} = \underline{1} \underline{\times} \underline{a} = \underline{a};$$

2.4) For each element $\underline{a} \in \underline{F}$, there is an element $\underline{a^{-1}} \in \underline{F}$, called the "*isoinverse of* $\underline{a}$", which is such that

$$\underline{a} \underline{\times} (\underline{a}^{-1}) = (\underline{a}^{-1}) \underline{\times} \underline{a} = \underline{1};$$

3) Axioms of joint isoaddition and isomultiplication.

3.1) The set $\underline{F}$ is closed under joint addition and isomultiplication, i.e., for all $\underline{a}$, $\underline{b}$, $\underline{c} \in \underline{F}$ we have

$$\underline{a} \underline{\times} (\underline{b} \underline{+} \underline{c}) \in \underline{F}, \quad (\underline{a} \underline{+} \underline{b}) \underline{\times} \underline{c} \in \underline{F};$$

3.2) All elements $\underline{a}$, $\underline{b}$, $\underline{c} \in F$ verify the "*isodistributive laws*"

$$\underline{a} \underline{\times} (\underline{b} \underline{+} \underline{c}) = (\underline{a} \underline{\times} \underline{b}) \underline{+} (\underline{b} \underline{\times} \underline{c}), \quad (\underline{a} \underline{+} \underline{b}) \underline{\times} \underline{c} = (\underline{a} \underline{\times} \underline{c}) \underline{+} (\underline{b} \underline{\times} \underline{c});$$

When there exists a least positive integer p such that the equation $\underline{p} \underline{\times} \underline{a} = o$, admits solution for all elements $\underline{a} \in \underline{F}$, then $\underline{F}$ is said to have "*isocharacteristic p*". Otherwise, $\underline{F}$ is said to have "*isocharacteristic zero*".

A realization of the isomultuplication for the binary case is given by

$$\underline{a} \underline{\times} \underline{b} := \underline{(a_1, a_2)} \underline{\times} (b_1, b_2) = (a_1 \underline{\times} b_1, a_2 \underline{\times} b_2) := (a_1 \times U_1 \times b_1, a_2 \times U_2 \times b_2)$$

where $\times$ is the conventional multiplication, and U_k represents fixed elements generally outside F, the isotopic elements. In this case the isounit is given by

$\underline{1} := (U_1^{-1}, U_2^{-1})$ where U_1^{-1} and U_2^{-1} are the ordinary inverses.

2 GENERALIZED STRUCTURABLE ALGEBRAS

In this section we have considered the field F of characteristic different than 2 or 3. As well known, Lie algebras L can be conceived as a linear vector space, not necessarily finite dimensional with elements x, y, z, …, and abstract product [x , y] = xy – yx over a field F which verifies the axioms

$$[x , y] + [y , x] = 0, \tag{2.1}$$

$$[[x , y] , z] + [[y , z] , x] + [[z , x] , y] = 0, \tag{2.2}$$

for all x, y, z $\in$ L, where the product xy is generally assumed to be that of the enveloping associative algebra U(L) of L.

One of the important reason for which Lie algebras are introduced in physics is that their product [x , y] characterizes the brackets of the evolution depending on time t, i.e., dx/dt = [x , h] where the element h is called the Hamiltonian and generally represents the total energy.

In 1992 N. Kamiya [8] has introduced a generalized structurable algebra. This structure has been defined as the generally nonassociative algebra A over the field F equipped with a nontrivial derivation D(x , y) verifying the axioms

$$D(x , y) + D(y , x) = 0, \tag{2.3}$$

$$D(xy , z) + D(yz , x) + D(zx , y) = 0, \tag{2.4}$$

for all x, y, z $\in$ A.

It is obvious that axioms (2.3) and (2.4) are a generalization of the conventional Lie algebra's axioms (2.1), respectively (2.2). As a result, the generalized structurable algebras are a significant generalization of Lie algebras.

Independent from these, R. Santilli introduced in 1978 the isotopies of Lie algebras. He defined this structure as the lifting of the Lie algebra L with element x, y, z,…, and product [x , y] = xy – yx over into infinitely possible Lie isotopic algebras $\underline{L}$ which coincide with L as vector spaces, but are defined over an isofield $\underline{F}$ with respect to infinitely possible new products $\underline{[x , y]}$ = x*y – y*x under the condition to preserve the original axioms (2.1) and (2.2),

$$\underline{[x , y]} + \underline{[y , x]} = 0, \ (2.5)$$
$$\underline{[[x , y] , z]} + \underline{[[y , z] , x]} + \underline{[[z , x] , y]} = 0, \ (2.6)$$

For all x, y, z $\in \underline{L}$.

We present below the same isotopies of the associative product xy which were identified with consequantial isotopies of the attached Lie-isotopic product

$$x*y = axy,\ a \neq 0 \in F, \tag{2.7}$$

$$x*y = xUy, \tag{2.8}$$

$$x*y = QxQyQ,\ Q^2 = QQ = Q, \tag{2.9}$$

where U and Q are fixed and nowhere null elements generally outside L.
We can observe that isotopies (2.7) and (2.8) admit the left and right unit $\underline{1} = a^{-1}$, respectively $\underline{1} = U^{-1}$, but (2.9) does not admit it.

Theorem 2.1 *Let A be a generalized structurable algebra over a field K equipped with a derivation D(x, y); let U be a nonsingular and hermitian element. Consider there is an element V so that $V^2 = U$ and $Vx, xV \in$* A. Then A (we can denote it by $\underline{A}_2$) *is a generalized structurable algebra over K with respect to the product and the derivation defined by a new structure*

$$x*y := xUy,$$
$$D^*(x, y) := D(VxV, VyV).$$

Theorem 2.2 [6] Let A be a generalized structurable algebra equipped with a derivation D(x, y). Then (A, *) is a generalized structurable algebra equipped with D*(x , y) : = D(x , y) and the new product

$$X*y := xy - kyx$$

Where k is a scalar element. Then

$$D(kx, y) = D(x, ky) = kD(x, y$$

Note that when k = 1, we have a special case of Lie-Santilli isotopy.

Corollary *Let (L , [,])be a lie algebra, then the results from Theorem 2.2 hold for*

$$x*y = (1+k)[x, y].$$

Theorem 2.3 [6] *If A is a generalized structurable algebra equipped with D(x, y), U is a nonsingular and Hermitian element and V is an other element so that $V^2 = U$, then A is a generalized structurable algebra with respect to*

$$x*y := xUy - yUx$$
$$d^*(x, y) := D(Vxv, VyV).$$

We conclude, specifying that:

- the study of isofield of isocharacteristic $p \neq 0$, to see whether new fields, and therefore new Lie algebras over the isofields of isocharacteristic $p \neq 0$, is permitted by the isotopies;

- the study of the integral topology is characterized by isofields with integral realizations of their isounits;
- the generalized structurable algebras are significant for the investigation of the generalization of Lie algebras in general, and others.

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GREEDY AND LAZY EXPANSIONS

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Abstract: *There are many ways to represent real numbers. In this paper we present some of these expansions, namely expansion in integer base and in non–integer base. Thus, we define the greedy and the lazy expansion and present some of the ergodic properties of these expansions.*

Keywords: β *- expansions, greedy, lazy.*

1 EXPANSION IN INTEGER BASES

As is well–known, it is quite straightforward to develop any $x \in [0,1)$ in a series of expansion in any integer base $r > 1$. Almost every $x \in [0,1]$ has a unique r-ary expansion of the form

$$x = \sum_{k=1}^{\infty} \frac{a_k}{r^k},\ a_k \in \{0,1,\ldots,r-1\}, \qquad (1.1)$$

also denoted by $x = .a_1 a_2 \ldots a_n \ldots$. Only rationals that can be written as $\frac{l}{r^m}$, $l \in \{0,1,\ldots,r^m - 1\}$, $m \in \mathbf{N}$ have two different expansions of the form (1.1), one of them being finite while the other expansion ends in an infinite string of $(r-1)$'s. Note that $x = 1$ has only one expansion of the form (1.1) given by

$$1 = \sum_{k=1}^{\infty} \frac{r-1}{r^k}.$$

If $0 \le x < 1$, one can generate r-ary expansions by iterating the map $T_r : [0,1) \to [0,1)$ given by

$$T_r(x) = rx(\mathrm{mod}1),$$

and the digits $a_k = a_k(x)$, $k \ge 1$, are given by

$$a_k = \left[r T_r^{k-1}(x) \right],\ k \ge 1.$$

Notice that $a_k = i \Leftrightarrow T_r^{k-1}(x) \in \left[\frac{i}{r}, \frac{i+1}{r} \right)$, where $i \in \{0,1,\ldots,r-1\}$.

It is well–known that the Lebesgue measure λ is T_r-invariant, i.e., $\lambda\left(T_r^{-1}(A)\right)=\lambda(A)$, for every Borel set A in $[0,1)$, and that T_r is related to the Bernoulli–shift on r symbols, with uniform product measure.

2 GREEDY EXPANSIONS

The situation is quite different in case of a non–integer $\beta>1$. As in the integer case, any number $x\in[0,1)$ has an expansion in base β of the form

$$x=\sum_{k=1}^{\infty}\frac{b_k}{\beta^k},\ b_k\in\{0,1,\ldots,[\beta]\}. \tag{2.1}$$

However, for a given non–integer $\beta>1$, almost every $x\in[0,1)$ has infinitely many different series expansions of the form (2.1). As in the r-ary case, an expansion of $x\in[0,1)$ of the form (2.1) can be obtained by setting $b_k=b_k(x)=\left[\beta T_\beta^{k-1}(x)\right]$, for $k\geq 1$, where the *greedy map* $T_\beta:[0,1)\to[0,1)$ is given by

$$T_\beta(x)=\beta x(\operatorname{mod}1).$$

Indeed, by induction one easily verifies that for $n\geq 1$,

$$T_\beta^n(x)=\beta^n x-\beta^{n-1}b_1-\beta^{n-2}b_2-\ldots-\beta b_{n-1}-b_n.$$

Rewriting, one gets

$$x=\frac{b_1}{\beta}+\ldots+\frac{b_n}{\beta^n}+\frac{T_\beta^n(x)}{\beta^n}.$$

Letting $n\to\infty$, the claim follows. In this case we speak of the *β- expansion of x* or the *greedy expansion of x*.

Rényi introduced these maps T_β, and studied their statistical properties. He showed that T_β is ergodic with respect to λ, i.e., any Borel set A satisfying $T_\beta^{-1}(A)=A$ has Lebesgue measure 0 or 1. He also showed that λ is equivalent to a T_β - invariant probability measure μ_β with density h_β satisfying

$$1-\frac{1}{\beta}\leq h_\beta(x)\leq\frac{1}{1-\frac{1}{\beta}}.$$

Due to this, statistical properties of the β- expansion of x, such as the frequency of digits, follow easily from Birkhoff's Ergodic Theorem.

For example, for $\beta=G$, one has that two consecutive digits $b_k(x)$ and $b_{k+1}(x)$ cannot be independent, since a digit 1 must always be followed by a digit 0. In this case, Rényi was able to find that

$$h_\beta(x)=\begin{cases}\dfrac{5+3\sqrt{5}}{10}, & 0\le x<\dfrac{\sqrt{5}-1}{2}\\[2mm] \dfrac{5+\sqrt{5}}{10}, & \dfrac{\sqrt{5}-1}{2}\le x<1,\end{cases}$$

and obtained from this the asymptotic frequency of zeros. If we denote by $1_{\left[0,\frac{1}{G}\right)}$ the indicator function of the interval $\left[0,\frac{1}{G}\right)$, then by Birkhoff's Ergodic Theorem,

$$\lim_{n\to\infty}\frac{1}{n}\left|\left\{1\le i\le n:b_i(x)=0\right\}\right|=\lim_{n\to\infty}\frac{1}{n}\sum_{i=0}^{n-1}1_{\left[0,\frac{1}{G}\right)}\left(T_\beta^i(x)\right)=$$

$$=\mu_\beta\left(\left[0,\frac{1}{G}\right)\right)=\int_0^{1/G}\frac{5+3\sqrt{5}}{10}\,dx=\frac{5+\sqrt{5}}{10}=0.7236\ldots a.e.$$

Let $T_\beta(1):=\beta-[\beta]$ and $T_\beta^n(1):=T_\beta^{n-1}\left(T_\beta(1)\right)$ for $n\ge 2$. It was shown that

$$h_\beta(x)=\frac{1}{F(\beta)}\sum_{n=0}^{\infty}\frac{1}{\beta^n}1_{\left[0,T_\beta^n(1)\right)}(x),\ \text{for } 0\le x<1, \tag{2.2}$$

where $F(\beta)$ is the normalizing constant. Also, it was shown that for each $\beta>1$ the system $\left([0,1),\mu_\beta,T_\beta\right)$ is weak–Bernoulli.

In order to obtain expansions of the form (2.1) for any number $x\in\left[0,\frac{[\beta]}{\beta-1}\right]$, we will extend the definition of T_β by setting

$$T_\beta(x)=\begin{cases}\beta x(\operatorname{mod}1), 0\le x<1\\ \beta x-[\beta], 1\le x\le\dfrac{[\beta]}{\beta-1}.\end{cases}$$

Let

$$C(d)=\left[\frac{d}{\beta},\frac{d+1}{\beta}\right),\ \text{for } d\in\left\{0,\ldots,[\beta]-1\right\}$$

and

$$C([\beta])=\left[\frac{[\beta]}{\beta},\frac{[\beta]}{\beta-1}\right).$$

If we set $b_k=d\left(T_\beta^{k-1}(x)\right)$, where

$$d(x)=d \text{ if and only if } x\in C(d),\ d\in\left\{0,\ldots,[\beta]\right\},$$

then the argument given above shows that we obtain an expansion of the form (2.1) indeed.

Moreover,

$$T_\beta^n(x) = \beta^n \sum_{k=n+1}^{\infty} \frac{b_k}{\beta^k}, \text{ for } n \geq 0.$$

By induction, one easily verifies that for $x \in \left[0, \frac{[\beta]}{\beta - 1}\right]$, the digits b_n, $n \geq 1$, of the β-expansion of x are recursively given by the following *greedy algorithm*:

$$b_n = b \text{ (with } 0 \leq b \leq [\beta] - 1) \Leftrightarrow \sum_{k=1}^{n-1} \frac{b_k}{\beta^k} + \frac{b}{\beta^n} \leq x < \sum_{k=1}^{n-1} \frac{b_k}{\beta^k} + \frac{b+1}{\beta^n},$$

and

$$b_n = [\beta] \Leftrightarrow x \geq \sum_{k=1}^{n-1} \frac{b_k}{\beta^k} + \frac{[\beta]}{\beta^n}.$$

If $x \in \left[0, \frac{[\beta]}{\beta - 1}\right]$, then we call the expansion of the form (2.1) satisfying $b_k = d\left(T_\beta^{k-1}(x)\right)$ for each $k \geq 1$ again the greedy expansion or the β-expansion of x. Note that this definition is consistent with our earlier definition in case $x \in [0,1)$.

Note that for each $x \in \left[0, \frac{[\beta]}{\beta - 1}\right]$ there exists a nonnegative integer $n_0 = n_0(x)$ such that for all $n \geq n_0$ one has that $T_\beta^n(x) \in [0,1)$. In view of this, we let h_β be as before on $[0,1)$, and we define $h_\beta(x) = 0$ for $1 \leq x \leq \frac{[\beta]}{\beta - 1}$. Moreover, we denote the measure with density h_β defined on $\left[0, \frac{[\beta]}{\beta - 1}\right]$ again by h_β. Then the system

$$\left(\left[0, \frac{[\beta]}{\beta - 1}\right], \mu_\beta, T_\beta\right)$$

is ergodic (in fact is weak–Bernoulli), since the "original" system on $[0,1)$ is.

3 LAZY EXPANSIONS

In paper by Erdös, Joó, Komornik, Loreti and others, the so–called *lazy expansion* in base $\beta \in (1,2)$ has been studied. In general, for a non–integer $\beta > 1$, the digits $\left(\tilde{b}_k\right)_{k \geq 1}$ of the lazy expansion of $x \in \left[0, \frac{[\beta]}{\beta - 1}\right]$ are recursively given by

$$\tilde{b}_n = 0 \Leftrightarrow \sum_{k=1}^{n-1} \frac{\tilde{b}_k}{\beta^k} + \frac{[\beta]}{\beta^{n+1}} + \frac{[\beta]}{\beta^{n+2}} + \ldots \geq x \tag{3.1}$$

and $\tilde{b}_n = b$ (with $1 \leq b \leq [\beta]$) if and only if both

$$\sum_{k=1}^{n-1} \frac{\tilde{b}_k}{\beta^k} + \frac{b-1}{\beta^n} + \frac{[\beta]}{\beta^{n+1}} + \frac{[\beta]}{\beta^{n+2}} + \ldots < x \tag{3.2}$$

and

$$\sum_{k=1}^{n-1} \frac{\tilde{b}_k}{\beta^k} + \frac{b}{\beta^n} + \frac{[\beta]}{\beta^{n+1}} + \frac{[\beta]}{\beta^{n+2}} + \ldots \geq x \tag{3.3}$$

are satisfied. By induction we always have that for $n \in \mathbf{N}$

$$\sum_{k=1}^{n} \frac{\tilde{b}_k}{\beta^k} \leq x \leq \sum_{k=1}^{n} \frac{\tilde{b}_k}{\beta^k} + \frac{[\beta]}{\beta^{n+1}} \sum_{k=0}^{\infty} \frac{1}{\beta^k}.$$

Since,

$$\lim_{n\to\infty} \frac{[\beta]}{\beta^{n+1}} \sum_{k=0}^{\infty} \frac{1}{\beta^k} = \lim_{n\to\infty} \frac{[\beta]}{\beta^n} \frac{1}{\beta-1} = 0,$$

it follows that the series expansion $\sum_{k=1}^{\infty} \frac{\tilde{b}_k}{\beta^k}$ of x converges to x.

For $x \in \left[0, \frac{[\beta]}{\beta-1}\right]$ and $n \in \mathbf{N}$, set

$$\tilde{t}_{n-1} = \tilde{t}_{n-1}(x) = \beta^{n-1} \sum_{k=n}^{\infty} \frac{\tilde{b}_k}{\beta^k}.$$

Since

$$x = \sum_{k=1}^{n-1} \frac{\tilde{b}_k}{\beta^k} + \sum_{k=n}^{\infty} \frac{\tilde{b}_k}{\beta^k} = \sum_{k=1}^{n-1} \frac{\tilde{b}_k}{\beta^k} + \frac{1}{\beta^{n-1}} \tilde{t}_{n-1},$$

it follows from (3.1), (3.2) and (3.3) that

$$\tilde{b}_n = 0 \Leftrightarrow \tilde{t}_{n-1} \leq \frac{[\beta]}{\beta(\beta-1)},$$

and, if $d \in \{0, \ldots, [\beta]\}$

$$\tilde{b}_n = d \Leftrightarrow \frac{[\beta]}{\beta(\beta-1)} + \frac{d-1}{\beta} < \tilde{t}_{n-1} \leq \frac{[\beta]}{\beta(\beta-1)} + \frac{d}{\beta}.$$

In view of this, we define the *lazy map* $S_\beta : \left[0, \frac{[\beta]}{\beta-1}\right] \to \left[0, \frac{[\beta]}{\beta-1}\right]$ by

$$S_\beta = \beta x - d, \text{ for } x \in \Delta(d),$$

where

$$\Delta(0)=\left[0,\frac{[\beta]}{\beta(\beta-1)}\right],$$

and

$$\Delta(d)=\left(\frac{[\beta]}{\beta(\beta-1)}+\frac{d-1}{\beta},\frac{[\beta]}{\beta(\beta-1)}+\frac{d}{\beta}\right],\ d\in\{0,\ldots,[\beta]\}.$$

Hence, to get the defining partition one starts from $\frac{[\beta]}{\beta-1}$ by taking $[\beta]$ intervals of length $\frac{1}{\beta}$ from right to left. The first interval $\Delta(0)$ with endpoints 0 and $\frac{[\beta]}{\beta(\beta-1)}$, corresponding to the lazy digit 0, is longer than the rest.

Further,

$$\tilde{t}_n(x)=S_\beta^n(x),\ \text{for}\ n\geq 0.$$

Note that from the dynamics of S_β it follows that for every number $x\in\left[0,\frac{[\beta]}{\beta-1}\right]$, there exists a nonnegative integer $n_0=n_0(x)\in\mathbf{N}$ such that

$$S_\beta^n(x)\notin\left[0,\frac{[\beta]+1-\beta}{\beta-1}\right],\ \text{for all}\ n\geq n_0,$$

i.e., the interval $A_\beta=\left(\frac{[\beta]+1-\beta}{\beta-1},\frac{[\beta]}{\beta-1}\right]$ is an *attractor* of the map S_β (of length 1).

Now, let $l:\left[0,\frac{[\beta]}{\beta-1}\right]\to\left[0,\frac{[\beta]}{\beta-1}\right]$ be given by

$$l(x)=\frac{[\beta]}{\beta-1}-x,$$

then $l([0,1))=A_\beta$. We have the following result.

Theorem 3.1 *The map* $l:\left[0,\frac{[\beta]}{\beta-1}\right]\to\left[0,\frac{[\beta]}{\beta-1}\right]$ *is measurable and* $l\circ T_\beta=S_\beta\circ l$. *Furthermore, the system*

$$\left(\left[0,\frac{[\beta]}{\beta-1}\right],\rho_\beta,S_\beta\right)\ \textit{is weakly–Bernoulli,}$$

where ρ_β *is the lazy measure on* $\left[0,\frac{[\beta]}{\beta-1}\right]$, *given by*

$$\rho_\beta(A) = \mu_\beta\left(l^{-1}(A)\right), \textit{ for any Borel set } A \subset \left[0, \frac{[\beta]}{\beta-1}\right].$$

For $x \in \left[0, \frac{[\beta]}{\beta-1}\right]$, we define the greedy convergents $C_n = C_n(x)$ and the lazy convergents $\tilde{C}_n = \tilde{C}_n(x)$, $n \geq 1$ of x by

$$C_n := \sum_{k=1}^{n} \frac{b_k}{\beta_k} \text{ and } \tilde{C}_n := \sum_{k=1}^{n} \frac{\tilde{b}_k}{\beta_k}.$$

It can be shown that there exist expansions of x in base β which are neither lazy nor greedy for which the convergents (sometimes) perform better than the greedy convergents.

In order to compare the quality of approximation of the two algorithms, we define for $n \geq 0$, the *approximation coefficients* $\theta_n = \theta_n(x)$ and $\tilde{\theta}_n = \tilde{\theta}_n(x)$ by $\theta_0(x) = \tilde{\theta}_0(x) := x$, $\theta_n = \theta_n(x) := \beta^n(x - C_n)$ and $\tilde{\theta}_n = \tilde{\theta}_n(x) := \beta^n\left(x - \tilde{C}_n\right)$, for $n \geq 1$.

Clearly, $T_\beta^n(x) = \theta_n$ and $S_\beta^n(x) = \tilde{\theta}_n$ for $n \geq 0$. But then it follows from Birkhoff's Ergodic Theorem that the limits

$$\lim_{n\to\infty} \frac{1}{n} \sum_{k=0}^{n-1} \theta_n(x) \text{ and } \lim_{n\to\infty} \frac{1}{n} \sum_{k=0}^{n-1} \tilde{\theta}_n(x) \text{ exist}$$

and equal

$$M_{greedy} := \int_0^{\frac{[\beta]}{\beta-1}} x h_\beta(x)\,dx, \text{ respectively } M_{lazy} := \int_0^{\frac{[\beta]}{\beta-1}} x d_\beta(x)\,dx,$$

for almost all x.

The following result states that on average for almost all x the greedy convergents approximate x *better* than the lazy convergents of x.

Proposition 3.2 *If* $\beta > 1$ *is a non-integer, then*

$$M_{greedy} + M_{lazy} = \frac{[\beta]}{\beta-1} \textit{ and } M_{greedy} < M_{lazy}.$$

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RANDOM β - EXPANSIONS

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Abstract: *In this paper we study random expansions to non–integer base* $\beta > 1$. *We also discuss the uniqueness of expansions and present the basic properties of random* β *-expansions.*

Keywords: β *- expansions, greedy and lazy maps.*

1 INTRODUCTION

Let $\beta > 1$ be a real number, and $A = \{a_1, a_2, \ldots, a_m\}$ a given set of real numbers. We assume that $a_1 < a_2 < \ldots < a_m$, and that $m \geq 2$. We are interested in algorithms that generate β - expansions of the form

$$x = \sum_{k=1}^{\infty} \frac{b_k}{\beta^k}, \tag{1.1}$$

with $b_k \in A$. Clearly, such an expansion is possible for points in the interval $\left[\frac{a_1}{\beta-1}, \frac{a_m}{\beta-1}\right]$, but not necessarily for all points in this interval. There are two cases that have been studied. The first is when $\beta = r$ is an integer, and $A = \{0, 1, \ldots, r-1\}$, leading to the well–known r- ary expansion of points in $[0,1]$. Each point has a unique expansion except for points of the form $\frac{k}{r^n}$, $0 < k \leq r^n - 1$ which have exactly two expansions. The second case is when $\beta > 1$ is non–integer, and $A = \{0, 1, \ldots, [\beta]\}$, is *a complete digit set*. In this case, almost every $x \in \left[0, \frac{[\beta]}{\beta-1}\right]$ has a continuum number of expansions of the form

$$x = \sum_{k=1}^{\infty} \frac{a_k}{\beta^k},\ a_k \in \{0, 1, \ldots, [\beta]\},\ k \geq 1. \tag{1.2}$$

There are two well–known algorithms producing β - expansions with a complete digit set, the *greedy* and the *lazy* algorithms. The greedy algorithm chooses at each step the largest possible digit, while the lazy chooses the smallest possible digit. Dynamically, the greedy algorithm is generated by iterating the map T_β defined on $\left[0, \frac{[\beta]}{\beta-1}\right]$ by

$$T_\beta(x)=\begin{cases}\beta x(\mathrm{mod}1), 0 \le x < 1\\ \beta x-[\beta], 1 \le x \le \dfrac{[\beta]}{\beta-1}.\end{cases} \tag{1.3}$$

Similarly, the lazy algorithm is obtained by iterating the map L_β defined on the interval $\left[0, \frac{[\beta]}{\beta-1}\right]$ by

$$L_\beta = \beta x - d \text{, for } x \in \Delta(d), \tag{1.4}$$

where

$$\Delta(0)=\left[0, \frac{[\beta]}{\beta(\beta-1)}\right],$$

and

$$\Delta(d)=\left(\frac{[\beta]}{\beta-1}-\frac{[\beta]-d+1}{\beta}, \frac{[\beta]}{\beta-1}-\frac{[\beta]-d}{\beta}\right]=$$

$$=\left(\frac{[\beta]}{\beta(\beta-1)}+\frac{d-1}{\beta}, \frac{[\beta]}{\beta(\beta-1)}+\frac{d}{\beta}\right], \ d \in \{1,\ldots,[\beta]\}.$$

2 SOME PROPERTIES OF RANDOM β-EXPANSIONS

In this section we will discuss a new class of series expansions to any non–integer base $\beta > 1$. If we superimpose the greedy map and the lazy map corresponding to the same β, we have $[\beta]$ so called *switch regions* on which the greedy map and the lazy map differ. These regions are intervals, given by

$$S_k = \left[\frac{k}{\beta}, \frac{[\beta]}{\beta(\beta-1)}+\frac{k-1}{\beta}\right], \text{ for } k = 1,\ldots,[\beta].$$

On these intervals the greedy map has the form $T_\beta(x) = \beta x - k$, while the lazy map is given by $L_\beta(x) = \beta x - (k-1)$. Outside these regions, both maps coincide. To generate new expansions of the form (1.2) that are neither greedy nor lazy, one can iterate maps described as follows. Divide each switch region into two subintervals. On the left subinterval let the new map N be equal to the lazy map and on the right subinterval be equal to the greedy map. Outside these switch regions N is a greedy map, which is also the lazy map. In this section we will consider the case when each switch region is divided in the same proportion. For each

$$\alpha \in \left[0, \frac{[\beta]}{\beta-1} - 1\right]$$

we will define a map $N_{\beta,\alpha}$ on $\left[0, \frac{[\beta]}{\beta-1}\right]$, which has as attractor the interval $[\alpha, \alpha+1]$. Just as the greedy map T_β and the lazy map L_β, the map $N_{\beta,\alpha}$ generates a series expansion (1.2) in the base β. Let the partition points $d_1, \ldots, d_{[\beta]}$ be given by:

$$d_i := \frac{\alpha+i}{\beta},\ i = 1, \ldots, [\beta].$$

Then $N_{\beta,\alpha} : \left[0, \frac{[\beta]}{\beta-1}\right] \to \left[0, \frac{[\beta]}{\beta-1}\right]$ is defined by

$$N_{\beta,\alpha}(x) := \begin{cases} \beta x, & x \in [0, d_1) \\ \beta x - i, & x \in [d_i, d_{i+1}), 1 \le i < [\beta], \\ \beta x - [\beta x], & x \in \left[d_{[\beta]}, \frac{[\beta]}{\beta-1}\right]. \end{cases}$$

In order to understand better the dynamical properties of $N_{\beta,\alpha}$, consider the map $\psi^* : [\alpha, \alpha+1] \to [0,1]$, given by $\psi^*(x) := \alpha + 1 - x$. Let

$$T^*(x) = \psi^*\left(N_{\beta,\alpha}\left(\psi^{*^{-1}}(x)\right)\right).$$

We have the following lemma.

Lemma 2.1 *Let* $\beta > 1$ *be a non–integer, and let* $\alpha \in \left[0, \frac{[\beta]}{\beta-1} - 1\right]$. *Then*

$$T^*(x) = \beta x + \alpha^* \pmod 1,$$

where $\alpha^* = [\beta] - (\alpha+1)(\beta-1)$.

Instead of dividing the switch regions into two parts, one can also flip a coin in order to decide whether to apply the greedy map or the lazy map. More precisely, set $\Omega = \{0,1\}^{\mathbf{N}}$ and let $K_\beta : \Omega \times \left[0, \frac{[\beta]}{\beta-1}\right] \to \Omega \times \left[0, \frac{[\beta]}{\beta-1}\right]$ be given by

$$K_\beta(\omega,x)=\begin{cases}(\omega,T_\beta(x)), & \text{if } x\in E_k, k=0,\dots,[\beta],\\ (\sigma(\omega),T_\beta(x)), & \text{if } x\in S_k \text{ and } \omega_1=1,\ k=1,\dots,[\beta],\\ (\sigma(\omega),L_\beta(x)), & \text{if } x\in S_k \text{ and } \omega_1=0, k=1,\dots,[\beta].\end{cases}$$

where: $E_k=\left(\frac{[\beta]}{\beta(\beta-1)}+\frac{k-1}{\beta},\frac{k+1}{\beta}\right)$, $k=1,\dots,[\beta]-1$, $E_0=\left[0,\frac{1}{\beta}\right)$, and $E_{[\beta]}=\left(\frac{[\beta]}{\beta(\beta-1)}+\frac{[\beta]-1}{\beta},\frac{[\beta]}{\beta-1}\right]$, $S=\bigcup_{k=1}^{[\beta]}S_k$ and $E=\bigcup_{k=0}^{[\beta]}E_k$.

The elements of Ω represent the coin tosses used every time the orbit $\left\{\pi_2\left(K_\beta^n(\omega,x)\right):n\geq 0\right\}$ hits a switch region. Here,

$$\pi_2:\Omega\times\left[0,\frac{[\beta]}{\beta-1}\right]\to\left[0,\frac{[\beta]}{\beta-1}\right]$$

denotes the canonical projection onto the second coordinate.

Let:

$$d_1=d_1(\omega,x)=\begin{cases}k, & \text{if } x\in E_k, k=0,\dots,[\beta],\\ & \text{or } (\omega,x)\in\{\omega_1=1\}\times S_k,\ k=1,\dots,[\beta],\\ k-1, & \text{if } (\omega,x)\in\{\omega_1=0\}\times S_k \text{ and } \omega_1=0, k=1,\dots,[\beta].\end{cases}$$

Then:

$$K_\beta(\omega,x)=\begin{cases}(\omega,\beta x-d_1), & \text{if } x\in E\\ (\sigma(\omega),\beta x-d_1), & \text{if } x\in S.\end{cases}$$

Set $d_n=d_n(\omega,x)=d_1\left(K_\beta^{n-1}(\omega,x)\right)$. Then

$$\pi_2\left(K_\beta^n(\omega,x)\right)=\beta^n x-\beta^{n-1}d_1-\dots-\beta d_{n-1}-d_n,$$

i.e.

$$x=\frac{d_1}{\beta}-\dots-\frac{d_n}{\beta^n}+\frac{\pi_2\left(K_\beta^n(\omega,x)\right)}{\beta^n},$$

and from here:

$$x-\sum_{i=1}^{n}\frac{d_i}{\beta^i}=\frac{\pi_2\left(K_\beta^n(\omega,x)\right)}{\beta^n}\to 0,\ n\to\infty.$$

This shows that for all $\omega\in\Omega$ and for all $x\in\left[0,\frac{[\beta]}{\beta-1}\right]$ one has that:

$$x=\sum_{i=1}^{\infty}\frac{d_i}{\beta^i}=\sum_{i=1}^{\infty}\frac{d_i(\omega,x)}{\beta^i}.$$

The random procedure described shows that with each $\omega \in \Omega$ corresponds an algorithm that produces expansions in base β. Further, if we identify the point (ω, x) with $(\omega,(d_1(\omega,x),d_2(\omega,x),\dots))$, then the action of K_β on the second coordinate corresponds to the left shift.

The next theorem shows that for all $x \in \left[0, \frac{[\beta]}{\beta-1}\right]$, any representation of x of the form $x = \sum_{i=1}^{\infty} \frac{a_i}{\beta^i}$ with $a_i \in \{0,1,\dots,[\beta]\}$ can be generated by means of the map K_β by choosing an appropriate $\omega \in \Omega$.

Theorem 2.1 *Let* $x \in \left[0, \frac{[\beta]}{\beta-1}\right]$ *and let* $x = \sum_{i=1}^{\infty} \frac{a_i}{\beta^i}$ *with* $a_i \in \{0,1,\dots,[\beta]\}$ *be a representation of* x *in base* β. *Then there exists an* $\omega \in \Omega$ *such that for all* $i \geq 1$, $a_i = d_i(\omega, x)$.

Remark. This theorem is equivalently with the fact that the greedy expansion of x is the only representation of x in base β if and only if $x_n \in E$ for all $n \geq 1$. In this case, we have for all $n \geq 1$, $x_n = T_\beta^{n-1}(x) = L_\beta^{n-1}(x)$.

Now, note that $1 \in S_{[\beta]} \cup E_{[\beta]}$ and $1 \in E_{[\beta]}$ if and only if $\frac{[\beta]}{\beta-1} - 1 \in E_0$. The following proposition gives a characterization of the case $1 \in E_{[\beta]}$ using the greedy expansion of 1.

Proposition 2.1 *Suppose that* 1 *has a greedy expansion of the form* $1 = \frac{b_1}{\beta} + \frac{b_2}{\beta^2} + \dots$.

i) *If* $b_i = 0$ *for all* $i \geq 3$, *then* $1 \in E_{b_1}$ *if and only if* $b_2 \geq 2$. *Moreover, if* $b_2 = 1$, *then* $1 = \frac{[\beta]}{\beta-1} - \frac{1}{\beta}$.

ii) *If* $b_i \geq 1$ *for some* $i \geq 3$, *then* $1 \in E_{b_1}$ *if and only if* $b_2 \geq 1$.

The following theorem represents the characterization of the uniqueness of expansions of $x \in \left[0, \frac{[\beta]}{\beta-1}\right]$.

Theorem 2.2 *Suppose that* $x \in \left[0, \frac{[\beta]}{\beta-1}\right]$ *has a greedy expansion of the form* $x = \frac{a_1}{\beta} + \frac{a_2}{\beta^2} + \ldots$. *Then,* x *has a unique expansion in base* β *if and only if for all* $n \geq 0$ *with* $a_{n+1} \geq 1$, *we have* $T_\beta^{n+1}(x) > \frac{[\beta]}{\beta-1} - 1$.

Corollary 2.1 *Suppose that* $x \in \left[0, \frac{[\beta]}{\beta-1}\right]$ *has a greedy expansion of the form* $x = \frac{a_1}{\beta} + \frac{a_2}{\beta^2} + \ldots$, *with* $a_i \geq 1$ *for all* $i \geq 1$. *Then,* x *has a unique expansion in base* β.

Corollary 2.2 *If* 1 *has a unique expansion in base* β, *then there exists a* $k \geq 1$ *such that in the greedy expansion of* 1, *every block of consecutive zeros consists of at most* k *terms.*

Definition 2.1 *An expansion is called infinite if it contains infinitely many nonzeros terms; otherwise it is called finite.*

Corollary 2.3 *Suppose that* 1 *has an infinite greedy expansion of the form* $1 = \frac{b_1}{\beta} + \frac{b_2}{\beta^2} + \ldots$, *with* $b_2 \geq 2$. *Let* $k \geq 1$ *be the unique integer such that* $\frac{1}{\beta^{k+1}} \leq \frac{b_1}{\beta-1} - 1 < \frac{1}{\beta^k}$. *If in the greedy expansion of* 1 *every block of consecutive zeros contains at most* $k-1$ *terms, then* 1 *has a unique expansion in base* β.

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PARALLEL ALGEBRAIC METHODS FOR THE CONTROLLABILITY PROBLEMS IN CONTROL THEORY

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***Abstract**: For the controllability and the eigenvalue assignment problems in control theory we give parallel algorithms that run in almost linear time on a parallel random access machine model. The algorithms make efficient use of the processors and are scalable which makes them of practical worth also in the case of limited parallelism.*

Keywords: *method, parallel, algorithms.*

1. CONTROLLABILITY

Let:

$$x'(t) = Ax(t) + Bu(t) \tag{1.1}$$

be a continuous-time linear control system and let:

$$x_{i+1} = Ax_i + Bu_i \tag{1.2}$$

be its discrete counterpart. Here A and B are constant matrices of dimensions $n \times n$ and $n \times m$, respectively, and $x(t)$ and $u(t)$ are time dependent vectors.

The system (1.1) is said to be controllable if a unique control vector $u(t)$ can be found such that, in some specified time, $u(t)$ will derive the system from the initial state $x(0)$ to a desired state $x(t)$. Since the system (1.2) is uniquely identified by the pair of matrices (A, B), we can refer to the controllability problem for (1.2) as to the problem of *controlling the pair* (A, B).

Many equivalent criteria for determining the controllability of (A, B) are known. If m is close to n or the matrix A is not in Hessemberg form, all these methods are characterized by an operation count as high as n^4, and are therefore impractical. For instance, Kalman's criterion requires that $\operatorname{rank}\left(B \middle| AB \middle| \ldots \middle| A^{n-1}B\right) = n$. We say that a matrix $A = (a)_{ij}$ is lower Hessemberg if $a_{ij} = 0$ for $j > i + 1$.

Let $a(x) = a_0 + a_1 x + \cdots + a_n x^n$ be a polynomial and let:

$$C_A = \begin{bmatrix} 0 & 1 & 0 & \cdots & 0 \\ \vdots & \ddots & 1 & \ddots & \vdots \\ \vdots & & \ddots & \ddots & 0 \\ 0 & \cdots & \cdots & 0 & 1 \\ -\dfrac{a_0}{a_n} & -\dfrac{a_1}{a_n} & \cdots & -\dfrac{a_{n-2}}{a_n} & -\dfrac{a_{n-1}}{a_n} \end{bmatrix}.$$

The matrix C_A is *the companion of the polynomial a*. Also, a matrix with the structure of C_A is said to be a *companion form.*

Given a matrix A, its companion C_A is the companion of its characteristic polynomial $\det(A-\lambda I) = (-1^n)\lambda^n + a_{n-1}\lambda^{n-1} + \cdots + a_1\lambda + a_0$.

It is easy to see that $\det(A-\lambda I) = \det(C_A - \lambda I)$, and thus that A and C_A have the same eigenvalues.

We assume in (1.2) that *A* is an $n \times n$ lower Hessemberg matrix while *B* is any $n \times m$ matrix, with $m < n$. The assumption that *A* be Hessemberg is not a great loss of generality. Also, it is known that a pair (M, N) is controllable if and only if (PMP^{-1}, PN) is, where *P* is any nonsingular. When the conditions above are satisfied (*A* Hessemberg and $m < n$) the sequential cost of the practical algorithms for solving the controllability problem is $O(n^3)$.

A system (1.1) in which the matrix *A* is companion is said in *dual phase variable canonical form.*

All the known controllability criteria, such as the one mentioned due to Kalman, reduce to testing the nonsingularity (or to computing the rank) of certain matrices. In our case, given a companion matrix *C*,

$$C = \begin{pmatrix} 0 & 1 & 0 & \dots & 0 \\ \vdots & \ddots & 1 & \ddots & \vdots \\ \vdots & & \ddots & \ddots & 0 \\ 0 & \dots & \dots & 0 & 1 \\ c_1 & c_2 & \dots & c_{n-1} & c_n \end{pmatrix} \tag{1.3}$$

and a vector **b**, consider the matrix $X = X_C(\mathbf{b})$ whose rows x_i^T are defined in the following way:

$$x_i^T = \begin{cases} \mathrm{b}^T & \text{if } i = n \\ x_{i+1}^T C - c_{i+1} x_n^T & \text{if } 1 \le i < n \end{cases} \tag{1.4}$$

Theorem 1.1 [6] *Let (C, B) be a system in dual phase variable canonical form. Let $\mathbf{b}_i$ denote the i-th column of $B, i = 1, \ldots, m$. Then (C, B) is controllable if and only if, for all $i \in \{1, \ldots, m\}$, $X_C(\mathbf{b}_i)$ is nonsingular.*

We now prove that the above criterion is well-suited for a number of computational approaches that are relevant from either a theoretical or a practical viewpoint.

Lema 1.1 *Let C be the companion matrix (1.3) and let* **b** *be an n vector. Computing the matrix* $X_C(\mathbf{b})$ *and testing its singularity takes* $O(n)$ *parallel time on an* $O(n^2)$ *processor .*

Proof Given the particular structure of the matrix *C*, the *i*-th row of $X_C(\mathbf{b})$, $i < n$, can be computed in 3 parallel steps using $2n-1$ processors. Therefore $X_C(\mathbf{b})$ can be computed in $3(n-1)$ parallel steps using $2n-1$ processors. To test whether $X_C(\mathbf{b})$ is singular, parallel algorithms exist which requires $O(n)$ time on $O(n^2)$ processors ([5]).

It easily follows from Theorem 1.1 and Lemma 1.1 that the controllability of a system in dual phase variable canonical form can be tested in parallel time $O(n)$ using $O(mn^2)$ processors. If we also consider the transformation from Hessemberg to companion, then we obtain slightly superlinear time (i.e. $O(n\log n)$). We now show that the criterion of Theorem 1.1 is also suitable for very fast (i.e. polylogarithmic time) parallel implementations. Let $a(x) = a_0 + a_1 x + \ldots + a_n x^n$ and $b(x) = b_0 + b_1 x + \ldots + b_n x^n$ be polynomials. It can be easily verified that the expression $\dfrac{a(x)b(y)-b(x)a(y)}{z-y}$ is a polynomial in *x* and *y*, i.e.

$$\frac{a(x)b(y)-b(x)a(y)}{z-y} = \sum_{j,k=0}^{n-1} \beta_{jk} x^j y^k .$$

The matrix $B = (\beta_{jk})$ is called the *Bezoutian* of $a(x)$ and $b(x)$. The Bezoutian associated with $a(x)$ and $b(x)$ is denoted by $Bez(a,b)$. The following lemma can be easily proved.

Lemma 1.2 *Let* C_a *be the companion matrix associated with the polynomial* $a(x)$*. Then,* $C_a^k = Bez(a,1)^{-1} Bez(a, y^k)$.

The important fact, from the computational point of view, is that both $Bez(a,1)$ and $Bez(a, y^k)$ are Hankel matrices. More precisely,

$$Bez(a,1) = \begin{pmatrix} a_1 & a_2 & \ldots & a_n \\ a_2 & & a_n & \\ \vdots & \iddots & & \\ a_n & & & \end{pmatrix}$$

while $Bez(a, y^k)$ is block diagonal with only two blocks, i.e.

$$Bez(a, y^k) = \begin{pmatrix} B_1 & O \\ O & B_2 \end{pmatrix},$$

where:

$$B_1 = \begin{pmatrix} & & & -a_0 \\ & & \iddots & -a_1 \\ & \iddots & \iddots & \vdots \\ -a_0 & -a_1 & \dots & -a_{k-1} \end{pmatrix}, \quad B_2 = \begin{pmatrix} a_{k+1} & a_{k+2} & \dots & a_n \\ a_{k+2} & & \iddots & \\ \vdots & \iddots & & \\ a_n & & & \end{pmatrix}.$$

Theorem 1.2 *Let $C = C_a$ be the companion of the polynomial $a(x)$, and let* **b** *be an n vector. For $i = 0,\dots,n-1$ define $c_{i+1} = -a_i/a_n$. Then computing the matrix $X = X_C(\mathbf{b})$, as defined in (1.4), takes time $O(\log^2 n)$ on an $O(nM(n))$ processors.*
Here, M(n) to denote the minimum number of processors that support $O(\log n)$ matrix multiplication.
Proof. From the recurrence

$$x_i^T = \begin{cases} \mathrm{b}^T & \text{if } i = n \\ x_{i+1}^T C_a - c_{i+1} x_n^T & \text{if } 1 \le i < n \end{cases}$$

it is possible to obtain the following explicit definition of the matrix *X*:

$$X = \begin{pmatrix} \mathbf{b}^T\left(C_a^{n-1} - c_n C^{n-2} - \dots - c_3 C_a - c_2 I\right) \\ \mathbf{b}^T\left(C_a^{n-2} - c_n C^{n-3} - \dots - c_3 I\right) \\ \vdots \\ \mathbf{b}^T\left(C_a^{2} - c_n C_a - c_{n-1} I\right) \\ \mathbf{b}^T\left(C_a - c_n I\right) \\ \mathbf{b}^T \end{pmatrix}$$

In other words, using Lemma 1.2, we have

$$x_k^T = -\sum_{j=1}^{n-k+1} c_{k+j}\mathbf{b}^T C_a^{j-1} = -\sum_{j=1}^{n-k+1} c_{k+j}\mathbf{b}^T Bez(a,1)^{-1} Bez(a, y^{j-1}) \tag{1.5}$$

where we set $c_{n+1} = -1$. The following algorithm, that computes (1.5), achives the bounds stated.
Algorithm 1
1. Solve the linear system $\mathbf{w}^T Bez(a,1) = \mathbf{b}^T$ in time $O(\log n)$ using $O(n)$ processors.
These bounds can be obtained thanks to the Hankel structure of $Bez(a,1)$.
2. Compute the products $\mathbf{w}_j^T = c_j \mathbf{w}^T$, $j = 2,\dots,n+1,$ in one step using n^2 processors.
3. Compute the vector-matrix products $\mathbf{w}_j^T Bez(a, y^k)$, $j = 2,\dots,n+1, k = 0,\dots, j-2$. This can be done in time $O(\log n)$ using $O(n^3/\log n)$ processors.
4. Compute $x_k^T, k = 1,\dots,n-1,$ in time $O(\log n)$ using $O(n^3/\log n)$ processors.
5. Compute $\det(X)$ in $O(\log^2 n)$ parallel time algorithms using $O(nM(n))$ processors.

Remark. We conclude this section by considering the controllability problem in case of single input, i.e. when B is a vector $(n=1)$. In this case, the reduction to the companion form is not required. To test the controllability of the pair (A, B), where A is lower Hessemberg, it is sufficient to test the singularity of the matrix X, with rows x_i, defined in the following way ([6]):

$$x_i^T = \begin{cases} B^T & \text{if } i = n, \\ \frac{1}{a_{i,i+1}}\left(x_{i+1}^T A - a_{i+1,i+1}x_{i+1}^T - \ldots - a_{n,i+1}x_n^T\right) & \text{if } 1 \le i < n, \end{cases}$$

Example.

We take into consideration the fixed part of the type "double integrator" described in the following continuous model:

$$\ddot{y}(t) = u(t).$$

One has to project a regulator after state which can assure to the poles a regulation system in closed circuit $z_{1,2} = \lambda_{1,2}$.

Solving.

By introducing the states:

$$x_1(t) = y(t), x_2(t) = \dot{y}(t),$$

the following continuous input-state-output model is being obtained for the fixed part:

$$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix} = \begin{bmatrix}0 & 1\\ 0 & 0\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u(t),\ y(t) = \begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix},$$

or:

$$\dot{x} = Ax + bu,\ y = c^T x.$$

To determine the discrete model firstly one must calculate the matrix Φ and the vector Γ , by taking into account a sampling period T=2.

$$\Phi = e^{AT} \approx I + AT = \begin{bmatrix}1 & 0\\ 0 & 0\end{bmatrix} + \begin{bmatrix}0 & T\\ 0 & 0\end{bmatrix} = \begin{bmatrix}1 & T\\ 0 & 1\end{bmatrix},$$

$$\Gamma = \int_0^T e^{Ap}bdp = \int_0^T \begin{bmatrix}1 & p\\ 0 & 1\end{bmatrix}\begin{bmatrix}0\\ 1\end{bmatrix}dp = \begin{bmatrix}T^2/2\\ T\end{bmatrix}.$$

With Φ and Γ known, the discrete model of the fixed part becomes:

$$\begin{bmatrix}x_1(k+1)\\ x_2(k+1)\end{bmatrix} = \begin{bmatrix}1 & T\\ 0 & 1\end{bmatrix}\begin{bmatrix}x_1(k)\\ x_2(k)\end{bmatrix} + \begin{bmatrix}T^2/2\\ T\end{bmatrix}u(k),\ y(k) = \begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1(k)\\ x_2(k)\end{bmatrix},$$

or

$$x(k+1) = \Phi x(k) + \Gamma u(k),\ y(k) = c^T x(k).$$

On the grounds of this, now one can apply the procedure for the determining of the controllability of the discrete system and for the poles distributing.

For a sampling period T=2, Φ and Γ have the form:

$$\Phi = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}, \quad \Gamma = \begin{bmatrix} 2 \\ 2 \end{bmatrix}.$$

Determining the controllability.

1° Due to the fact that Γ is a vector, in this case the reduction to the companion form is not required. The controllability test of the pair (Φ, Γ), where Φ is a matrix in an inferior Hessemberg form, is reduced to establishing the singularity of matrix X with the lines x_i defined by:

$$x_i^T = \begin{cases} \Gamma^T & i = n \\ \dfrac{1}{\phi_{i,i+1}} \left(x_{i+1}^T \Phi - \phi_{i+1,i+1} x_{i+1}^T - \cdots - \phi_{n,i+1} x_n^T \right) & 1 \le i < n \end{cases}.$$

$$x_i^T = \begin{cases} \Gamma^T = [2 \quad 2] & i = 2 \\ \dfrac{1}{\phi_{12}} \left(x_2^T \Phi - \phi_{22} x_2^T \right) = \dfrac{1}{2} \left([2 \quad 2] \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - [2 \quad 2] \right) = [0 \quad 2] & i = 1 \end{cases}.$$

Consequently, matrix X is:

$$X = \begin{bmatrix} 0 & 2 \\ 2 & 2 \end{bmatrix}$$

and $\det X \neq 0$, which demonstrates the controllability of the pair (Φ, Γ).

The distribution of the poles.

1° The matrix $L = (l_1 | \ldots | l_n)$ is formed, defined by:

$$l_n = \Gamma, \; l_i = (\Phi - \lambda_{i+1} I) l_{i+1}, \quad i = n-1, \ldots, 1.$$

meaning:

$$l_2 = \begin{bmatrix} 2 \\ 2 \end{bmatrix}, \; l_1 = \left(\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - \lambda_2 I \right) \begin{bmatrix} 2 \\ 2 \end{bmatrix} = \begin{bmatrix} 1-\lambda_2 & 2 \\ 0 & 1-\lambda_2 \end{bmatrix} \begin{bmatrix} 2 \\ 2 \end{bmatrix} = \begin{bmatrix} 2(3-\lambda_2) \\ 2(1-\lambda_2) \end{bmatrix}.$$

Matrix L becomes:

$$L = \begin{bmatrix} 2(3-\lambda_2) & 2 \\ 2(1-\lambda_2) & 2 \end{bmatrix}.$$

2° Calculate $r = (\Phi - \lambda_1 I) l_1$ meaning:

$$r = \left(\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - \lambda_1 I \right) \begin{bmatrix} 2(3-\lambda_2) \\ 2(1-\lambda_2) \end{bmatrix} = \begin{bmatrix} 1-\lambda_1 & 2 \\ 0 & 1-\lambda_1 \end{bmatrix} \begin{bmatrix} 2(3-\lambda_2) \\ 2(1-\lambda_2) \end{bmatrix} = \begin{bmatrix} 2(5 - 3\lambda_1 - 3\lambda_2 + \lambda_1 \lambda_2) \\ 2(1-\lambda_1)(1-\lambda_2) \end{bmatrix}$$

3° Solve the linear system $L^T f = e_1$, where $e_1 = (1,0,\ldots,0)^T$:

$$\begin{bmatrix} 2(3-\lambda_2) & 2(1-\lambda_2) \\ 2 & 2 \end{bmatrix} \begin{bmatrix} f_1 \\ f_2 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix},$$

$$\begin{cases} 2(3-\lambda_2) f_1 + 2(1-\lambda_2) f_2 = 1 \\ 2 f_1 + 2 f_2 = 0 \end{cases}$$

with the solution

$$\begin{bmatrix} f_1 \\ f_2 \end{bmatrix} = \begin{bmatrix} \dfrac{1}{4} \\ -\dfrac{1}{4} \end{bmatrix}.$$

4° Calculate $\Sigma = r f^T$ and return $\Phi - \Sigma$:

$$\Sigma = \begin{bmatrix} 2(5 - 3\lambda_1 - 3\lambda_2 + \lambda_1\lambda_2) \\ 2(1-\lambda_1)(1-\lambda_2) \end{bmatrix} \begin{bmatrix} \dfrac{1}{4} & -\dfrac{1}{4} \end{bmatrix} = \frac{1}{2}\left[5 - 3\lambda_1 - 3\lambda_2 + \lambda_1\lambda_2 - (1-\lambda_1)(1-\lambda_2)\right]$$

$$= 2 - \lambda_1 - \lambda_2.$$

$$\Phi - \Sigma = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - (2 - \lambda_1 - \lambda_2) I = \begin{bmatrix} \lambda_1 + \lambda_2 - 1 & 2 \\ 0 & \lambda_1 + \lambda_2 - 1 \end{bmatrix}.$$

2. CONCLUSIONS

In this paper we had shown that a number of problems arising in control theory can be solved using standard linear algebraic computations. As an immediate consequence, for some of the problems in control theory we obtain practical (i.e. processor efficient and scalable) parallel algorithms that are essentially constituted of sequences of calls to linear algebra routines.

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PARALLEL ALGEBRAIC METHODS FOR THE EIGENVALUE ASSIGNMENT PROBLEMS IN CONTROL THEORY

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Abstract: *For the controllability and the eigenvalue assignment problems in control theory we give parallel algorithms that run in almost linear time on a parallel random access machine model. The algorithms make efficient use of the processors and are scalable which makes them of practical worth also in the case of limited parallelism.*

Keywords**:** *method, parallel, eigenvalue.*

1 EIGENVALUE ASSIGNMENT

Let:

$$x'(t) = Ax(t) + Bu(t) \tag{1.1}$$

be a continuous-time linear control system and let:

$$x_{i+1} = Ax_i + Bu_i \tag{1.2}$$

be its discrete counterpart. Here A and B are constant matrices of dimensions $n \times n$ and $n \times m$, respectively, and $x(t)$ and $u(t)$ are time dependent vectors.

Given a pair of matrices (A, B), the *Eigenvalue Assignment Problem* (often referred to as the *pole placement problem* in control theory) is the problem of finding a feedback matrix *F* such that $A + BF$ has a desired spectrum Ω. To point out the importance of the *Eigenvalue Assignment Problem*, suppose that the pair (A, B) is controllable but unstable. Then it is natural to investigate whether it can be stabilized by means of a feedback matrix *F*. Thus the *Eigenvalue Assignment Problem* is very important in the process of designing a control system.

There are various sequential methods available for solving the pole placement problem. Among the best known are:

- the implicit QR methods [4];
- the matrix equation approach [3];
- the solution via the real Schur form [7];

Some of these approaches do not seem to be suitable for parallel processing. For instance, in the implicit QR-type methods the eigenvalues are assigned one at the time.

Here, we present a processor efficient parallel algorithm for the single input case, i.e. when $B = \mathbf{b}$ is a vector. The algorithm is based on one presented in [2] and it does not require that the matrix *A* be transformed into Hessemberg form. This allows us to prove that the parallel time complexity of the problem is much smaller than linear.

Let A be $n \times n$ and let **b** be an n vector. Also, let $\Omega = \{\lambda_1, \ldots, \lambda_n\}$ be the desired spectrum. We consider the following algorithm.

Algorithm 1

1. Construct the matrix $L = (\mathbf{l}_1 | \ldots | \mathbf{l}_n)$ defined by

$$\mathbf{l}_n = \mathbf{b},$$
$$\mathbf{l}_i = (A - \lambda_{i+1} I)\mathbf{l}_{i+1}, \quad i = n-1, \ldots, 1.$$

2. Compute $\mathbf{r} = (A - \lambda_1 I)\mathbf{l}_1$.
3. Solve $L^T \mathbf{f} = \mathbf{e}_1$, where $\mathbf{e}_1 = (1, 0, \ldots, 0)^T$.
4. Compute $C = \mathbf{r}\mathbf{f}^T$ and return $A - C$.

Theorem 1.1 *Assume that* $(A, \mathbf{b})$ *is controllable. Then the matrix* $A - C$ *of Algorithm 2 has the desired spectrum* Ω.

Proof By writing down the matrix L explicitly

$$L = \left((A - \lambda_2 I) \ldots (A - \lambda_n I)\mathbf{b} | \ldots | (A - \lambda_n I)\mathbf{b} | \mathbf{b}\right)$$

we can easily verify the following equality $AL - LB = R,$ where

$$B = \begin{pmatrix} \lambda_1 & 1 & 0 & \ldots & 0 \\ 0 & \lambda_1 & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & \ddots & 0 \\ \vdots & \ldots & \ddots & \ddots & 1 \\ 0 & \ldots & \ldots & 0 & \lambda_n \end{pmatrix}$$

and R is a matrix with all zeros except for the first column, **r**, that equals $(A - \lambda_1 I)\mathbf{l}_1$. Now, if $(A, \mathbf{b})$ is controllable, then by the Kalman's characterization of controllability it follows that the matrix $(A^{n-1}\mathbf{b} | \ldots | A\mathbf{b} | \mathbf{b})$ is nonsingular. But clearly this is equivalent to saying that L is nonsingular, since its i^{th} column can be expressed as $P_{i-1}(A)\mathbf{b}$, where $P_{i-1}(x)$ is a polynomial of degree exactly $i-1, i = 1, \ldots, n$. Thus there is a unique solution f to the system $L^T \mathbf{f} = \mathbf{e}_1$. Putting all this together we obtain:

$$A - C = A - \mathbf{r}\mathbf{f}^T = \mathbf{r}\mathbf{e}_1^T L^{-1} = A - RL^{-1} = LBL^{-1}.$$

That is, $A - C$ is similar to B and has the same spectrum as B.

A processor efficient implementation of Algorithm 1 can be obtained by using processor efficient implementation of the single steps. This easily leads to an $O(n \log n)$

time bound using $O(n^2/\log n)$ processors. However, using Algorithm 1 we can also prove that the complexity of the single input pole placement problem is $O(\log^2 n)$.

Theorem 1.2 ([6]) Solving the system of linear equations $Ax = b$, computing *det (A)*, and computing *rank(A)* can all be done in parallel time $O(\log^2 n)$ provided that $O(nM(n))$ processors are available.

Here, M(n) to denote the minimum number of processors that support $O(\log n)$ matrix multiplication.

Lemma 1.1 *Let A be an any* $n \times n$ *matrix and let* **b** *be an n vector. Also, as in Theorem 1.2, let* $M(n)$ *denote the minimum number of processors that support* $O(\log n)$ *matrix multiplication. Then the set of vectors* $A^n\mathbf{b}, A^{n-1}\mathbf{b}, \ldots, A\mathbf{b}, \mathbf{b}$ *can be computed in parallel time* $O(\log^2 n)$ *using* $M(n)$ *processors.*

Proof Let $\bar{n} = \lceil \log n \rceil$. We first compute the matrix powers $A^2, A^4, \ldots, A^{2\bar{n}}$.

Clearly, this can be done in $O(\log^2 n)$ parallel time using $M(n)$ processors. Now we recursively define a set of matrices $B_i, i = 0, \ldots, \bar{n}$, in the following way.

$$
\begin{aligned}
B_0 &= (\mathbf{b}|\mathbf{0}|\ldots|\mathbf{0}) \\
B_i &= \left(B_1^{(i-1)}\middle|\ldots\middle|B_{2^{i-1}}^{(i-1)}\middle|A^{2^{i-1}}B_1^{(i-1)}\middle|\ldots\middle|A^{2^{i-1}}B_{2^{i-1}}^{(i-1)}\middle|\mathbf{0}\middle|\ldots\middle|\mathbf{0}\right)
\end{aligned}
$$

where $B_k^{(j)}$ denotes the *k*th column of the matrix B_j. In other words, the first 2^{i-1} columns of B_i coincide with the correspondent columns of B_{i-1}, the next 2^{i-1} columns are the first 2^{i-1} columns of $A^{2^{i-1}}B_{i-1}$ and the remaining columns are **0**. Clearly, the first *n* columns of $B_{\bar{n}}$ are the vectors that we want to compute. Moreover, the cost of computing B_i is essentially the cost of performing a matrix multiplication. Therefore the parallel time required to compute $B_{\bar{n}}$ is again $O(\log^2 n)$ provided that $M(n)$ processors are available.

Theorem 1.3 *Algorithm 1 solves the single input Eigenvalue Assignment Problem in parallel time* $O(\log^2 n)$ *using* $O(nM(n))$ *processors.*

Proof Consider the following $n \times (n+1)$ matrix $B = (\mathbf{r}|\mathbf{l}_1|\ldots|\mathbf{l}_n)$ where **r** and $\mathbf{l}_i$ are defined in Algorithm 1. Let $B^{(I)}$ denote the *I* th column of *B*. We already know that

$$
B^{(i)} = \prod_{j=1}^{n} (A - \lambda_j I)\mathbf{b} \qquad i = 1, \ldots, n+1,
$$

where we have set $\prod_{j=n+1}^{n}(A-\lambda_j I)=I$. We now show how to compute the matrix B in a very fast and efficient way. Consider, for instance, the computation of the first column $B(1)=\mathbf{r}$. It is well known that the coefficients of the polynomial

$$p_1(\lambda)=\prod_{j=1}^{n}(\lambda-\lambda_j)=\lambda^n+\alpha_1\lambda^{n-1}+\ldots+\alpha_{n-1}\lambda+\alpha_n$$

can be computed in parallel time $O(\log n)$ using $O(n)$ processors. These bounds can be achieved using the Fast Fourier Transform Algorithm. Once the coefficients α_i and the vectors $A^n\mathbf{b},\ldots,A\mathbf{b},\mathbf{b}$ are known, the vector $B(1)$ can be determined in the following way

$$B(1)=A^n\mathbf{b}+\alpha_1A^{n-1}\mathbf{b}+\ldots+\alpha_{n-1}A\mathbf{b}+\alpha_n\mathbf{b}.$$

The computation of $B(1)$ using the above formula can be done in parallel time using $O(\log n)$ using $O(n^2/\log n)$ processors. Since the computation of the columns of B can be performed in parallel, it follows that B can be determined in parallel time $O(\log n)$ using $O(n^3/\log n)$ processors. Taking the computation of the vectors $A^i\mathbf{b}$ into account (see Lemma 1.1) brings the time bound to $O(\log^2 n)$ but leaves the processor bound unchanged, since clearly $M(n)=O(n^3/\log n)$. The last step of Algorithm 1 can be also be performed within the above bounds. Therefore, the overall cost of the Algorithm 1 is dominated bu Step 3, which asks for the solution of a linear system. By Theorem 1.2 this requires $O(\log^2 n)$ using $O(nM(n))$ processors.

Example

We take into consideration the fixed part of the type "double integrator" described in the following continuous model:

$$\ddot{y}(t)=u(t).$$

One has to project a regulator after state which can assure to the poles a regulation system in closed circuit $z_{1,2}=\lambda_{1,2}$.

Solving

By introducing the states:

$$x_1(t)=y(t),\ x_2(t)=\dot{y}(t),$$

the following continuous input-state-output model is being obtained for the fixed part:

$$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix}=\begin{bmatrix}0 & 1\\ 0 & 0\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u(t),\ y(t)=\begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix},$$

or

$$\dot{x} = Ax + bu\,,\ \ y = c^T x\,.$$

To determine the discrete model firstly one must calculate the matrix Φ and the vector Γ, by taking into account a sampling period T=2.

$$\Phi = e^{AT} \approx I + AT = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} + \begin{bmatrix} 0 & T \\ 0 & 0 \end{bmatrix} = \begin{bmatrix} 1 & T \\ 0 & 1 \end{bmatrix},$$

$$\Gamma = \int_0^T e^{Ap} b dp = \int_0^T \begin{bmatrix} 1 & p \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} dp = \begin{bmatrix} T^2/2 \\ T \end{bmatrix}.$$

With Φ and Γ known, the discrete model of the fixed part becomes:

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} 1 & T \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} T^2/2 \\ T \end{bmatrix} u(k),\ y(k) = \begin{bmatrix} \blacksquare & 0 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix},$$

or

$$x(k+1) = \Phi x(k) + \Gamma u(k)\,,\ y(k) = c^T x(k)\,.$$

On the grounds of this, now one can apply the procedure for the determining of the controllability of the discrete system and for the poles distributing.

For a sampling period T=2, Φ and Γ have the form:

$$\Phi = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix},\quad \Gamma = \begin{bmatrix} 2 \\ 2 \end{bmatrix}.$$

Determining the controllability.

1° Due to the fact that Γ is a vector, in this case the reduction to the companion form is not required. The controllability test of the pair (Φ, Γ), where Φ is a matrix in an inferior Hessemberg form, is reduced to establishing the singularity of matrix X with the lines x_i defined by:

$$x_i^T = \begin{cases} \Gamma^T & i = n \\ \dfrac{1}{\phi_{i,i+1}} \left(x_{i+1}^T \Phi - \phi_{i+1,i+1} x_{i+1}^T - \cdots - \phi_{n,i+1} x_n^T \right) & 1 \le i < n \end{cases}.$$

$$x_i^T = \begin{cases} \Gamma^T = \begin{bmatrix} 2 & 2 \end{bmatrix} & i = 2 \\ \dfrac{1}{\phi_{12}}\left(x_2^T \Phi - \phi_{22} x_2^T\right) = \dfrac{1}{2}\left(\begin{bmatrix} 2 & 2 \end{bmatrix}^T \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} 2 & 2 \end{bmatrix}^T\right) = \begin{bmatrix} 0 & 2 \end{bmatrix} & i = 1 \end{cases}.$$

Consequently, matrix X is:

$$X = \begin{bmatrix} 0 & 2 \\ 2 & 2 \end{bmatrix}$$

and $\det X \neq 0$, which demonstrates the controllability of the pair (Φ, Γ) .

The distribution of the poles.

1° The matrix $L = (l_1 \,|\, \ldots \,|\, l_n)$ is formed, defined by:

$$l_n = \Gamma,\ l_i = (\Phi - \lambda_{i+1} I) l_{i+1}, \quad i = n-1, \ldots, 1.$$

meaning:

$$l_2 = \begin{bmatrix} 2 \\ 2 \end{bmatrix},\ l_1 = \left(\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - \lambda_2 I\right)\begin{bmatrix} 2 \\ 2 \end{bmatrix} = \begin{bmatrix} 1-\lambda_2 & 2 \\ 0 & 1-\lambda_2 \end{bmatrix}\begin{bmatrix} 2 \\ 2 \end{bmatrix} = \begin{bmatrix} 2(3-\lambda_2) \\ 2(1-\lambda_2) \end{bmatrix}.$$

Matrix L becomes:

$$L = \begin{bmatrix} 2(3-\lambda_2) & 2 \\ 2(1-\lambda_2) & 2 \end{bmatrix}.$$

2° Calculate $r = (\Phi - \lambda_1 I) l_1$ meaning:

$$r = \left(\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - \lambda_1 I\right)\begin{bmatrix} 2(3-\lambda_2) \\ 2(1-\lambda_2) \end{bmatrix} = \begin{bmatrix} 1-\lambda_1 & 2 \\ 0 & 1-\lambda_1 \end{bmatrix}\begin{bmatrix} 2(3-\lambda_2) \\ 2(1-\lambda_2) \end{bmatrix} = \begin{bmatrix} 2(5 - 3\lambda_1 - 3\lambda_2 + \lambda_1\lambda_2) \\ 2(1-\lambda_1)(1-\lambda_2) \end{bmatrix}$$

3° Solve the linear system $L^T f = e_1,$ where $e_1 = (1, 0, \ldots, 0)^T$:

$$\begin{bmatrix} 2(3-\lambda_2) & 2(1-\lambda_2) \\ 2 & 2 \end{bmatrix}\begin{bmatrix} f_1 \\ f_2 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix},$$

$$\begin{cases} 2(3-\lambda_2)f_1 + 2(1-\lambda_2)f_2 = 1 \\ 2f_1 + 2f_2 = 0 \end{cases}$$

with the solution:

$$\begin{bmatrix} f_1 \\ f_2 \end{bmatrix} = \begin{bmatrix} \frac{1}{4} \\ -\frac{1}{4} \end{bmatrix}.$$

4° Calculate $\Sigma = rf^T$ and return $\Phi - \Sigma$:

$$\Sigma = \begin{bmatrix} 2(5-3\lambda_1-3\lambda_2+\lambda_1\lambda_2) \\ 2(1-\lambda_1)(1-\lambda_2) \end{bmatrix} \begin{bmatrix} \frac{1}{4} & -\frac{1}{4} \end{bmatrix} = \frac{1}{2}\left[5-3\lambda_1-3\lambda_2+\lambda_1\lambda_2-(1-\lambda_1)(1-\lambda_2)\right]$$

$$= 2-\lambda_1-\lambda_2.$$

$$\Phi - \Sigma = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - (2-\lambda_1-\lambda_2)I = \begin{bmatrix} \lambda_1+\lambda_2-1 & 2 \\ 0 & \lambda_1+\lambda_2-1 \end{bmatrix}.$$

2 CONCLUSIONS

In this paper we had shown that a number of problems arising in control theory can be solved using standard linear algebraic computations. As an immediate consequence, for some of the problems in control theory we obtain practical (i.e. processor efficient and scalable) parallel algorithms that are essentially constituted of sequences of calls to linear algebra routines.

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SOME CONSIDERATIONS OF IRREDUCTIBLE STOCHATIC MATRICES

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Abstract: *In the theory of finite and homogeneous Markov chains by first order, a great importance for the demonstration of their proprieties has the graph associated to the chain and the graph associated to a positive matrix.*
In this paper we will refer to some properties of the irreductible matrices and, also to a characterization of the cyclical Markov chains using some properties of the mentioned graphs.

Keywords**:** *stochatic, matrice, Marko chains.*

1 INTRODUCTION

The recent mathematical researches offer many answers to the themes that broach the conjunction between varies mathematical domains and the conjunction between mathematical domain and many other domains of research. In this context, the approach of important domains of probability theory and special of Markov chains theory using the mathematical models of graphs theory have a great importance.

In ([1], [4]) is given the model of the graph associated to the finite and homogeneous Markov chain by first order $X(n)_{n\geq o}$, with:

- the states set $S = \ 1, 2, ..., n \ $,

- the initial distribution

$$p_1, p_2, ..., p_n \ , p_i \geq 0, i = 1, 2, ..., n \text{ and } \sum_{i=1}^{n} p_i = 1 \tag{1}$$

- and the transition matrix

$$P = (p_{ij})_{i,j=1,2,...,n} \tag{2}$$

The two models of graph are given:

1. The graph $G = \ S, \Gamma \ $, where:

- S is the states set of chain

- and the function $\Gamma : S \to S$ that is defined in the following mode

$$\Gamma(i) = \ j \,/\, p_{ij} > 0 \ , (\forall) i \in S \tag{3}$$

or:

2. The graph $G_1 = \; S_1, \Gamma_1 \;$, where:

- $S_1 = S \cup \{0\}$ is the states set of chain

– and the function $\Gamma_1 : S_1 \to S$ that is defined in the following mode

$$\Gamma_1(i) = \; i / i \in S, p_i \neq 0 \quad \text{and } \Gamma_1 / S \equiv \Gamma \tag{4}$$

The oriented arcs of graph G_1 have the following evaluation:

- p_i is the value for the arcs $(0, i)$ and p_{ij} is the value for the arcs (i, j).

The graph G_1 contains all the information for the Markov chain. The correspondence between set of finite and homogeneous Markov chains by first order and the set of these graphs is mutual.

A great importance for the demonstration of properties of finite and homogeneous Markov chains by first order has the graph associated to a positive matrix ([3]).

The graph associated to the positive matrix $T = (t_{ij})_{i.j=1,2,...,n}$, $t_{ij} \geq 0$ is:

- $G_T = \; S, \Gamma \;$, where $S = \; 1, 2, ..., n$ and $\Gamma : S \to S$ is the function

$$\Gamma(i) = \; j / t_{ij} > 0 \; , (\forall) i \in S \tag{5}$$

2 PROPERTIES OF STOCHASTIC MATRICES

In the following we will refer to some properties of the irreductible matrices and, also to a characterization of the cyclical Markov chains using some properties of the mentioned graphs.

<u>*Definition*</u> 1 ([2]). A stochastic matrix P is called irreductible if and only if permutations of its lines and columns, it can't be write in the following form:

$$\begin{Vmatrix} P_{11} & 0 \\ P_{21} & P_{22} \end{Vmatrix} \tag{6}$$

where P_{11}, P_{22} are square matrices.

<u>*Proposition*</u> 1. A stochastic matrix P by order r is irreductible if and only if:

a) or, the graph $G_P = (S, \Gamma)$ associated to the matrix P is complete and symmetric, any node of its heaving a loop;

b) or, for any two nodes $i, j \in S$, in the associated graph, there is a path $[i = i_0, j_0, j_1, ..., j_{n-1}, j_n = j], n \geq 1,$ from the i-node to the j-node, where $S = \; 1, 2, ..., n$ is the set of the nodes and therefore of the matrix's indices.

Evidently, the path's length is at any rate two and the conditions a) and b) shows that the graph $G_P = (S, \Gamma)$ is strongly connected.

<u>*Proof*</u>. If P is irreductible then:

a) or $p_{ij} > 0$, for any $i, j \in S$, and therefore in the associated graph to the matrix any two nodes $i, j \in S$ are each other connected by two arcs (i, j) and (j, i), therefore the graph is complete and symmetric, and further because $p_{ii} \neq 0$, for any $i \in S$, any node has the loop;

b) or, any line of the matrix P has any rate a nenull element and therefore for any $i, j \in S$, there is n, $n \geq 1$, and $i = i_0, j_0, j_1, ..., j_{n-1}, j_n = j$ such that

$$p_{i_0 j_0} \cdot p_{j_0 j_1} \cdot ... \cdot p_{j_{n-1} j_n} > 0$$

and then, in the graph $G_P = (S, \Gamma)$ associated to the matrix P there is the path $[i = i_0, j_0, j_1, ..., j_{n-1}, j_n = j], n \geq 1,$ which has the length least two from the i-node to the j-node.

Reciprocally, if it is true the a)-hypothesis, therefore the graph $G_P = (S, \Gamma)$ associated to the matrix P is complete and symmetric and with loops, than any two nodes $i, j \in S$ are connected by two arcs, one (i, j) and other (j, i), and also for any $i \in S$, there is the arc (i, i), because the graph has loops in any node. therefore $p_{ij} > 0$, for any $i, j \in S$, and then the matrix P is irreductible.

If it is true the b)-hypothesis, that for any two nodes $i, j \in S$ belong to the graph $G_P = (S, \Gamma)$ associated to the matrix P, there is a path $[i = i_0, j_0, j_1, ..., j_{n-1}, j_n = j], n \geq 1,$ from the i-node to the j-node, then evidently that

$$p_{i_0 j_0} > 0, p_{j_0 j_1} > 0, ..., p_{j_{n-1} j_n} > 0$$

therefore any line of the matrix P has least a nenull element, consequently P is irreductible.

<u>*Corollary* 1.</u> Any regular stochastic matrix P is irreductible.

Proof. If P is a regular matrix then there is $k \geq 1$ such that $P^k > 0$ ([3]), but this means that in the graph $G_P = (S, \Gamma)$ associated to matrix P, any two nodes $i, j \in S$ are connected by a path which length least k, $k \geq 1$, and therefore in accordance with the Proposition 1 result that the matrix P is irreductible.

<u>*Remark* 1</u>. Evidently that, a Markov chain is irreductible if and only if the graph associated to the chain (therefore and the graph associated to the transition matrix P) is strongly connected ([4]), if and only if the matrix P is irreductible (proposition 1).

<u>*Definition* 2</u> ([2]). A irreductible stochastic matrix P is called periodically with the period d, $d > 1$, if by permutations of its lines and columns ([3]), we can it write in the following form:

$$P = \begin{Vmatrix} O & P_0 & O & \cdots & O \\ O & O & P_1 & \cdots & O \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ O & O & O & \cdots & P_{d-2} \\ P_{d-1} & O & O & \cdots & O \end{Vmatrix} \tag{7}$$

where O are the null matrix.

Definition 3 ([2]). A irreductible stochastic matrix P is called aperiodically, or by period $d = 1$, if it is not periodically.

Definition 4 ([4]). The oriented graph $G = S, \Gamma$ admits a d- cyclical decomposition, $d \geq 2$, if the nodes set S can be decomposed in d-sets $S_0, S_1, \ldots, S_{d-1}$, with $S_i \cap S_j = \varnothing$, $(\forall) i \neq j$, such that any arc (i, j) of the graph fulfills the following condition: if $i \in S_p$ then $j \in S_{p+1}$, for any $p < d - 1$, and $j \in S_0$ for $p = d - 1$.

A intuitive model of this definition are given in figure 1.

$$S_0 \to S_1 \to S_2 \to \cdots \to S_{d-2} \to S_{d-1} \to S_0$$

Figure 1

Remark 2. If the graph $G_P = S, \Gamma$ associated to the stochastic matrix P has the propriety enumerated in the definition 2 then by a permutation of its lines and columns, the matrix P this will have the form from the relation (7) and therefore the matrix P is periodically.

The matrix $P_0, P_1, \ldots, P_{d-1}$ is called $d -$ cyclical components of matrix P.

Using this result we will present a necessary and sufficient condition for a Markov chain to by cyclical.

Proposition 2. The necessary and sufficient condition for a irreductible Markov chain to by cyclical is that the graph associated to the chain admit a $d-$ cyclical decomposition.

Proof: If the chain is cyclical then the transition matrix P admits a decomposition like relation (2). The graph $G_P = S, \Gamma$ associated to the stochastic matrix P, equivalent to the graph associated to the chain, admit a $d-$ cyclical decomposition, each component S_i, $0 \leq i \leq d - 1$ of decomposition of the node`s set S being constitute by all the line (or column) indices which correspond to the matrices P_i, $0 \leq i \leq d - 1$.

From the relation (7) we also deduce that, the sets $S_0, S_1, \ldots, S_{d-1}$, have the property that $S_i \cap S_j = \varnothing$, $(\forall) i \neq j$.

Reciprocally, because the Markov chain is irreductible then, the graph associated to the chain is strongly connected. Therefore there is a cycle, who contain all the nodes of the graph. But from the hypothesis, the graph admits a $d-$ cyclical decomposition and then the stochastic matrix P will have the form (7) in accordance with remark 2.

It result that, the transition matrix P is cyclical and therefore the Markov chain is cyclical.

Remark 3. Applying the proposition 2 to a closed states class of finite and homogeneous Markov chains by first order (class that is recurrent also), we deduce that the elements of the $d-$ cyclical decomposition of the subgraph generated by the closed states class are also the cyclical subclass of the states class.

Remark 4. We also notice that, any m arcs (therefore any path or cycle from the graph) has the following property: if the beginning node is in S_i, and the ending node is in S_j, where S_i and S_j are the components of $d-$cyclical decomposition, then

$$j \equiv i + m(\mathrm{mod}\, d).$$

This relation obviously result from the definition 4.

Definition 4. The irreductible Markov chain is called regular (or acyclical, [2]), if there is a positive integer $t_0 > 1$ such that for any two states $i, j \in S$ (it is possible and $i = j$) in the graph associated to the chain there is a path from the $i-$node to the $j-$node, that it will have exactly t arcs, $t \geq t_0$ and t is a positive integer.

Proposition 3. If the graph $G = \langle S, \Gamma \rangle$, associated to the irreductible Markov chain, has at least a loop then the chain is regular.

Proof: We assume that $k \in S$ is a node of the graph $G = (S, \Gamma)$ associated to the irreductible Markov chain, that has a loop, then there is the arcs (k,k) in the graph. If $\|S\| = n$ then, because the chain is irreductible result that, there is at least a path from the any i-node to the $k-$node and from the $k-$node to the any j-node, with the length of path at least n (if it will be necessary, the loop of $k-$node may be included in the path such that the length of path to be n. Likewise, there is the paths with the length $2n$, and so on. If we take $t_0 = n$, evidently $t \geq t_0$ (for example $t = 2n$) with the property of definition 5, that proves that the irreductible Markov chain is regular.

Example: The chain, with the associated graph in the figure 2(a), is irreductible and irregular (because in this case $t_0 = 1$, in contradiction with definition 5) .

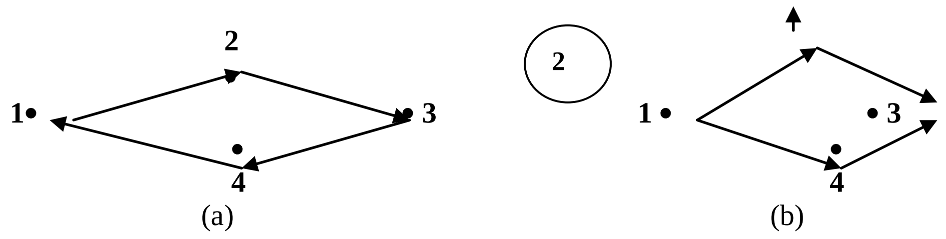

Figure 2.

Contrary, the chain, with the associated graph in the figure 2(b), is irreductible and regular (because in this case $t_0 \geq 4$, in accordance with proposition 3 and definition 5).

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FUZZY INTEGER TRANSPORTATION PROBLEM

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***Abstract**: In this paper is presented an algorithm which solves the fuzzy values transportation problem for request and offering and with the integrability condition imposed to the solution. The algorithm is exact and calculable effective even if the problem is formulated into a general manner, i.e. the fuzzy values for request and offering can be different one of the others and they are fuzzy numbers of a certain type.*

***Keywords:** transportion, algorithm, fuzzy values.*

1 INTRODUCTION

The transportation model has many applications, not just in transportation problem, but in the production scheduling problem.

The parameters of the each transportation problem are unitary costs (the profits) and the values for request and offering (production, storage capacity). In practice, these parameters are not always known and stables. In the next approached problem is supposed that the unitary costs (the profits) are known exactly, but the estimation of the values for request and offering (capabilities) is approximate. This inaccuracy results either of missing information or by a certain flexibility in capabilities planning of the considered factory. A frequently mean used to express the inaccuracy are the fuzzy numbers.

In the classical transportation problem with integer values for request and offering, there always exists an integer solution. This solution can be finding with the simplex transportation method, which is one of the most used methods for solving the transportation problems. This property (i.e. the possibility for finding an integer solution) is not kept in the fuzzy transportation problem with fuzzy values for request and offering, even if the characteristics of the existing fuzzy numbers in the problem are integers. To obtain an optimal integer solution (which would be necessary from flexibility rations) is used a special algorithm. Such an algorithm is presented in S. Chanas and D. Kuchta. Next, we present an algorithm which determines the optimal integer solution of a fuzzy transportation problem, *more general* than that considered in S. Chanas and D. Kuchta, just using the classical (non-parametric) transportation problem.

2 THE PROBLEM FORMULATION AND USED NOTATIONS

The considered fuzzy numbers are of $L-R$ type. A $L-R$ type fuzzy number A is: $A=\left(\underline{a},\overline{a},\alpha_A,\beta_A\right)_{L-R}$ and has the characteristic function:

$$\mu_A\left(t\right)=\begin{cases} L\left(\dfrac{\underline{a}-t}{\alpha_A}\right), & \text{for } t\le \underline{a} \\ 1, & \text{for } t\in\left[\underline{a},\overline{a}\right], t\in \mathbf{R} \\ R\left(\dfrac{t-\overline{a}}{\beta_A}\right), & \text{for } t\ge \overline{a} \end{cases}$$

where $\underline{a},\overline{a},\alpha_A,\beta_A\in\mathbf{R}_+$ and L, R are form function.

- F is a form function if F if continuous, decreasing on $\left[0,\infty\right)$, $F\left(0\right)=1$ and strictly decreasing on that side of the domain on which *F* is positive.

Examples:

- Linear: $F\left(y\right)=\max\left(0,1-y\right), y\ge 0$.
- Exponential: $F\left(y\right)=e^{-py}, p\ge 1, y\ge 0$.
- Power: $F\left(y\right)=\max\left(0,1-y^p\right), p\ge 1, y\ge 0$.
- Rational: $F\left(y\right)=\dfrac{1}{1+y^p}, p\ge 1, y\ge 0$

  There are particular cases when the functions L and R don't have any signification.

- $\underline{a}=-\infty$, $\mu_A\left(t\right)=1$, $t\le \overline{a}$.
-
- $\underline{a}=+\infty$, $\mu_A\left(t\right)=1$, $t\ge \underline{a}$.
-
- $\alpha_A=0$, $\mu_A\left(t\right)=0$, $t\le \overline{a}$.
-
- $\beta_A=0$, $\mu_A\left(t\right)=1$, $t\ge \overline{a}$.

The fuzzy transportation fuzzy considered here is enounced such as follow:

$$\begin{cases} C\ \ x\ \ = \min \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij} \\ \sum_{j=1}^{n} x_{ij} \cong A_i \quad i = \overline{1,m} \\ \sum_{i=1}^{m} x_{ij} \cong B_j \quad j = \overline{1,n} \\ x_{ij} \geq 0 \text{ and } x_{ij} \in \mathbf{Z}\ i = \overline{1,m},\ \ j = \overline{1,n} \end{cases} \tag{2.1}$$

where A_i, B_j are fuzzy numbers on the form:

$$A_i = \ \ \underline{a}_i, \overline{a}_i, \alpha_{A_i}, \beta_{A_i}\ \ L_i - R_i\,,\ \ i = \overline{1,m}\,,$$

$$B_j = \ \ \underline{a}_j, \overline{a}_j, \alpha_{A_j}, \beta_{A_j}\ \ S_j - T_j\,,\ \ j = \overline{1,n}\,.$$

- x is matrix solution (which components are the corresponding decisional variables), i.e., $x = \ \ x_{ij}\ \ _{m \times n}$. The unitary transportation costs c_{ij}, $i = \overline{1,m}$, $j = \overline{1,n}$ are supposed to be crisp numbers.

This problem formulation showed that the result is expressed again by a fuzzy number noted with G, de forma:

$$G = \ \ -\infty, c_0, 0, \beta_G\ \ _{L_G - R_G}$$

This problem is more complete than that treated in S. Chanas and D. Kuchta. The complexity consist in the following: here the pairs $\ L_i, R_i\ $, $i = \overline{1,m}$ and $\ S_j, T_j\ $, $j = \overline{1,n}$ can be different, while in S. Chanas and D. Kuchta they must be identical.

In the next definition is defined the fuzzy constraint concept and the fuzzy objective concept.

Definition 2.1

Let x an arbitrary solution of the problem (2.1).

a) The value $\mu_c\ \ x\ \ = \min\left\{ \mu_{A_i}\left(\sum_{j=1}^{n} x_{ij} \right), i = \overline{1,m}, \mu_{\beta_j}\left(\sum_{i=1}^{m} x_{ij} \right), j = \overline{1,n} \right\}$ is called the restrictions satisfaction degree for the problem (2.1).

b) $\mu_G(x) = \mu_G(c(x)) = \mu_G\left(\sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}x_{ij}\right)$ is called the objective satisfaction degree (the (2.1) problem result) by x.

- According to Belmann–Zadeh approach, a solution is called optimal solution if it is a solution to a problem where the restrictions and the objective are of maximal degree.

Definition 2.2

The minimized solution is a vector x for which $\mu_0(x) = \min\{\mu_c(x), \mu_G(x)\}$ attained the maximum. If the maximum value is 0, we tell that the problem (2.1) is insoluble.

3 THE SOLUTION OF THE PROBLEM

According to Definition 2.1, solving the problem (2.1) is equivalent with solving the following mathematical programming problem:

$$\min\{\mu_c(x), \mu_G(x)\} \to \max$$
$$x_{ij} \geq 0;\ x_{ij} \in \mathbf{Z},\ i = \overline{1,m},\ \ j = \overline{1,n}$$

Solving this mathematical programming problem is equivalent with solving the following problem:

$$\begin{cases} \lambda \to \max \\ \mu_G(x) \geq \lambda \\ \mu_{A_i}\left(\sum_{j=1}^{n} x_{ij}\right) \geq \lambda,\ \ i = \overline{1,m} \\ \mu_{B_j}\left(\sum_{i=1}^{m} x_{ij}\right) \geq \lambda,\ j = \overline{1,n} \\ \lambda > 0, x_{ij} \geq 0,\ x_{ij} \in \mathbf{Z},\ i = \overline{1,m},\ \ j = \overline{1,n} \end{cases} \tag{2.2}$$

To understand the following, we give the definition:

Definition 2.3

Let A be a fuzzy number. The λ-cut of A, denoted A^{λ}, is $A^{\lambda} = \{t \in \mathbf{R} \mid \mu_A(t) \geq \lambda\}$.

Now, it easy to observe that the hypotheses at A_i and B_j considered in this problem, the λ-cuts A_i^λ and B_j^λ are intervals, given by:

$$\begin{cases} A_i^\lambda = \left[\underline{a_i} - L_i^{-1} \ \lambda \ \cdot \alpha_{A_i}, \overline{a_i} + R_i^{-1} \ \lambda \ \beta_{A_i}\right], i = \overline{1,m} \\ B_j^\lambda = \left[\underline{b_j} - S_j^{-1} \ \lambda \ \cdot \alpha_{\beta_j}, \overline{b_j} + T_j^{-1} \ \lambda \ \beta_{B_j}\right], j = \overline{1,n} \end{cases} \qquad (2.3)$$

- The λ - cut for the fuzzy objective G is the set:
-

$$G^\lambda = \ -\infty, c_0 + R_G^{-1} \ \lambda \ \beta_G \Big] \qquad (2.4)$$

Take this into account the problem (2.2) can be rewritten as follows:

$$\begin{cases} \lambda \to \max \\ c \ \ x \ \ \geq G^\lambda \\ \sum_{j=1}^{n} x_{ij} \geq A_i^\lambda, \quad i = \overline{1,m} \\ \sum_{i=1}^{m} x_{ij} \geq B_j^\lambda, \ j = \overline{1,n} \\ \lambda > 0 \\ x_{ij} \geq 0, \ x_{ij} \in \mathbf{Z} \ , i = \overline{1,m}, \ \ j = \overline{1,n} \end{cases} \qquad (2.5)$$

The above problem is not transportation problem by reason of his objective function and the first condition. By this cause we cannot use the transportation algorithms to solve it. But, we can associate an interval transportation problem. Further, the solution of this auxiliary problem allows finding the solution of the problem (2.5), and from here, of the problem (2.1).

This auxiliary problem is given by:

$$\begin{cases} \sum_{j=1}^{n} x_{ij} \in A_i^\lambda, \quad i = \overline{1,m} \\ \sum_{i=1}^{m} x_{ij} \in B_j^\lambda, \ j = \overline{1,n} \\ x_{ij} \geq 0, \ x_{ij} \in \mathbf{Z}, \ i = \overline{1,m}, \ \ j = \overline{1,n} \end{cases} \qquad (2.6)$$

- Solving the problem (2.6) for a fixed $\lambda > 0$, allows to find if (2.5) is possible for this value of λ. Is suffices to verify if the value of the objective function value of the problem (2.6) verifies the first condition from (2.5). It is necessary that the maximum value of λ for which (2.5) is possible and the corresponding solution of (2.5).
- The end points of the intervals that appear in the conditions of the problem (2.6) can be non–integers. This mean that after we pass at the classical transportation problem described in (2.6), we could have a classical transportation problem with non–integers values for request and offering, and that's the reason why the classical algorithm does not guarantee obtaining of an integer solution. However, one can be replace the problem (2.6) with a problem (2.7), which has already the integer end points for the request and offering intervals without changing the set of the possible and optimal solutions.

For defining the problem (2.7) we use the following notation:

Definition 2.4

Let A *be an interval.* A is the largest interval with integer end points contained in A, *i.e.* $A = a,b$, *where* $a = \min\ t \,|\, t \in A \cap \mathbf{Z}$, $b = \max\ t \,|\, t \in A \cap \mathbf{Z}$.

With this notation the problem (2.7) which replaces the problem (2.6) is given by:

$$\begin{cases} c\ \ x \ \to \min \\ \sum_{j=1}^{n} x_{ij} \in \left[A_i^{\lambda}\right], \ \ i = \overline{1,m} \\ \sum_{i=1}^{m} x_{ij} \in \left[B_j^{\lambda}\right], \ j = \overline{1,n} \\ x_{ij} \geq 0, \ x_{ij} \in \mathbf{Z}, i = \overline{1,m}, \ \ j = \overline{1,n} \end{cases} \tag{2.7}$$

- The sets of the possible and optimal solutions of (2.6) and (2.7) are identical because of the integrability condition imposed to x.
- For $\lambda > 0$ fixed, one can resolve (2.5) by replacing with a classical integer values for request and offering transportation problem and it can be applied, for example, the simplex algorithm transportation problem.
- If one can solve (2.7) (or the corresponding classical transportation problem) as a problem with parameter λ, also one can be solved and the initial problem.
- However, the coefficients of the problem depend nonlinear on λ which determine some difficulty. To avoid solving a parameter transportation problem we propose the following algorithm which implies just solving a few classical transportation problems.
- The algorithm begin from the largest values of λ, i.e., $\lambda = 0$ and $\lambda = 1$. Is investigated for which values of λ, the problem (2.5) is admissible.

If is impossible for $\lambda = 0$, (2.1) is impossible.

If (2.5) is possible for $\lambda = 1$, then $\lambda = 1$ the optimal value of the objective function in (2.5) and the corresponding solution of (2.5) is, again, a solution for the problem (2.1).

If the problem (2.5) is possible for $\lambda = 0$ and impossible for $\lambda = 1$ (the most frequent case), we consider $\lambda = \frac{1}{2}$, and then $\left[0, \frac{1}{2}\right]$.

Acting in this manner we will approach from both sides to the optimal value of the objective function of (2.5). Thus, at each step one consider λ_1, λ_2 such that (2.5) is possible for $\lambda = \lambda_1$ and impossible for $\lambda = \lambda_2$. It's not necessary to divide this interval, when (2.7), for $\lambda = \lambda_1$, is a minimal extension of (2.7) for $\lambda = \lambda_2$ (just like in the definition 2.5).

Definition 2.5

The problem (2.7) for $\lambda = \lambda_1$ is a minimal extension when the problem (2.7) for $\lambda = \lambda_1$ is identical with problem (2.7) for $\lambda = \lambda^*$ where:

$$\lambda^* = \max\left\{ \max_{1\le i\le m, t\notin A_j^\lambda} \mu_{A_i}(t), \max_{1\le j\le n, t\notin B_j^\lambda} \mu_{B_j}(t) \right\}, \ t \in \mathbf{Z}.$$

From above sequence it follows that the corresponding algorithm (where the consecutive intervals of the values is divided in two) is finish after a finite number of steps, if we check at every step if the problem (2.7) for $\lambda = \lambda_1$ is a minimal extension of the problem (2.7) for $\lambda = \lambda_2$.

The user can determine λ_1, λ_2, starting with that conditions which must be verified.

The algorithm is given by:

Step 1

Set $\lambda(1) = 0$, $\lambda(2) = 1$.

Step 2

We solve the problem (2.7) for $\lambda = \lambda(1)$. If the problem is possible and $C(x(\lambda(1))) \in G^{\lambda(1)}$, then GO to Step 3. Else, the problem (2.1) is impossible.

Therefore, STOP (the problem (2.1) impossible and $\mu_D(x) = 0$, for all x).

Step 3

We solve the problem (2.7) for $\lambda = \lambda(2)$. If the problem is possible and $c(x(\lambda(2))) \in G^{\lambda(2)}$, then STOP, and $x(\lambda(2))$ is the optimal solution of the problem (2.1) and $\mu_D(x(\lambda(2))) = 1$. Else, GO to Step 4.

Step 4

Set $\lambda_m := \dfrac{\lambda(1) + \lambda(2)}{2}$ and GO to Step 5.

Step 5

We solve the problem (2.7) for $\lambda := \lambda_m$. If the problem is impossible, then $\lambda(2) := \lambda_m$ and GO to Step 6. Else, there are 3 possible cases:

i) $\mu_G(x(\lambda_m)) = \mu_C(x(\lambda_m))$, result that $x(\lambda_m)$ is an optimal solution of the problem (2.1) and STOP.

ii) $\mu_G(x(\lambda_m)) > \mu_C(x(\lambda_m))$, then we set $\lambda(1) = \mu_C x(\lambda_m)$ and GO to Step 6.

iii) $\mu_G(x(\lambda_m)) < \mu_C(x(\lambda_m))$, one set $\lambda(2) := \mu_C(x(\lambda_m))$ or, if $\lambda(2) = \mu_C(x(\lambda_m))$ GO to Step 6.

Step 6

If $\lambda(2) - \lambda(1) > \varepsilon$, then GO to Step 4. Else, we verify if the problem (2.7) for $\lambda = \lambda(1)$ is an minimal extension of the problem (2.7) for $\lambda = \lambda(2)$. If it is not, GO to Step 4. Else, STOP. A solution $x(\lambda(1))$ or $x(\lambda(2))$ is optimal for the problem (2.1).

If the problem (2.5) is impossible for $\lambda = \lambda(2)$, then $x(\lambda(1))$ is an optimal solution for the problem (2.1). ε is given by the user $(0.05 \le \varepsilon \le 0.1)$.

4 THE TRANSFORMATION OF AN INTERVAL TRANSPORTATION PROBLEM INTO A CLASSICAL ONE

We consider the problem:

$$\begin{cases} C(x) = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij} \to \min \\ \sum_{j=1}^{n} x_{ij} \in \left[a_i^1, a_i^2\right],\ i = \overline{1,m} \\ \sum_{i=1}^{m} x_{ij} \in \left[b_j^1, b_j^2\right],\ j = \overline{1,n} \\ x_{ij} \ge 0\ ;\ x_{ij} \in \mathbb{N},\ i = \overline{1,m},\ j = \overline{1,n} \end{cases} \tag{2.8}$$

The problem (2.8) can be transformed into a classical transportation problem where the values for request and offering are real adding the origins and destinations with

appropriate levels for request and offering just like in the transportation problem with interval restrictions. The corresponding classical transportation problem is given by:
There are $2m+1$ origins with values for the offering $i=\overline{1,2m+1}$:

$$a_i = a_i^1,\ \ i=\overline{1,m};\qquad a_i = a_{i-m}^2 - a_{i-m}^1,\ i=\overline{m+1,2m};\qquad a_{2m+1} = \sum_{j=1}^{n} b_j^2 - b_j^1\ .$$

There are $2n+1$ destinations with the following values of the request:

$$b_j = b_j^1,\ \ j=\overline{1,n};\ \ b_j = b_{j-m}^2 - b_{j-m}^1,\ j=\overline{n+1,2n};\qquad b_{2n+1} = \sum_{i=1}^{m} a_i^2 - \sum_{j=1}^{n} b_j^1 .$$

The costs coefficients d_{ij} will be defined as follows:

$$d_{ij} = c_{ij},\ \ i=\overline{1,m},\ \ j=\overline{1,n}$$
$$d_{ij} = c_{i-m,j},\ i=\overline{m+1,2m},\ \ j=\overline{1,n}$$
$$d_{ij} = c_{i,j-n},\ \ i=\overline{1,m},\ \ j=\overline{n+1,2n}$$

$d_{i,2n+1}$ is a bigger number, because the corresponding route is intensive for $i=\overline{1,m}$.
$d_{i,2n+1}=0$ for $i=\overline{m+1,2m}$.
$d_{2m+1,j}$ is a bigger number, because the corresponding route for $j=\overline{1,n}$ is intensive.
$d_{2m+1,j}=0$ for $j=\overline{n+1,2n}$.

Once we find a solution $\hat{x}=\left[\hat{x}_{ij}\right]_{2m+1\times 2n+1}$ of the auxiliary classical problem defined above, it can be obtained the solution of the problem (2.8) thus:

For $i=\overline{1,m}$ and $j=\overline{1,2n}$: $x_{ij} := \hat{x}_{ij} + \hat{x}_{m+i,j}$.

For $i=\overline{1,2m}$ and $j=\overline{1,n}$: $x_{ij} := \hat{x}_{ij} + \hat{x}_{i,j+n}$.

5 CONCLUSIONS

In this paper it was given an algorithm to solving the fuzzy transportation problem (with fuzzy values for request and offering and also for the objective) in the sense of maximizing the satisfaction both objectives and restrictions.

This algorithm demand beside a simple transformations, just solving the classical transportation problem (particulary is not necessary solving the parameter problem). The fuzzy numbers which defines the problem must not be trapezoidal.

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A GEOMETRIC CARACTERIZATION OF KOROVKIN SETS

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Abstract: *The present paper concerns itself with a geometrical approach to some Korovkin-type results.*

Keywords: *Korovkin, theory, geometry.*

1 PRELIMINARIES

Let X be a compact metric space. We consider:

$$T^+ = \{T : C(X) \to C(X) \mid T \text{ linear and positive}\} \tag{1}$$

$$T_1 = \{T : C(X) \to C(X) \mid T \text{ linear and } \|T\| \le 1\} \tag{2}$$

$$T_1^+ = T^+ \cap T_1 \tag{3}$$

and the corresponding sets: L^+ = the cone of positive linear functional on $C(X)$, L_1 = the unit ball of $(C(X))$ and $L_1^+ = L_1 \cap L^+$.

Def. 1.1: $S \subset C(X)$ is called an admissible set if:

(i) S separates the points of X;

(ii) S does not vanish on X.

We'll use the following notations: $G := < S >$; $\overline{G} := \overline{< S >}$ and G^*, the dual space of G.

If $L \in L^+, L_1, L_1^+$ and $x \in X$, we introduce the set:

$$L_x(S) = \{\mu \in L \mid \mu(g) = g(x), g \in S\} \tag{4}$$

We observe that: if $l(x) = \varepsilon_x|_G$, then L_X consists exactly of all these functional $\mu \in L$, that are extensions of l_x.

Now, we can prove next result:

Theorem 1.2: $S \subset C(X)$ is a Korovkin set with respect to T if:

$$(\forall) x \in X, L_x(S) = \{\varepsilon_x\} \tag{5}$$

Obs.1.3: (5) represents an analytical characterization of a Korovkin set S in $C(X)$.

Our purpose, now, will be to replace that analytical condition (5) by simpler condition of geometrical character.

2 A GEOMETRICAL APPROACH TO SOME KOROVKIN-TYPE RESULTS

Sets containing 1_X.

Let $S_0 \subset C(X)$, which separates the points of X and contains 1_X.

We consider: $G = < S_0 >$ and for $x \in X, l_x \in G^* \left(l_x(g) = g(x)\right)$. Now, let

$$\Phi : X \to G^*, \Phi(x) = l_x \tag{6}$$

We resume that Φ is a one-to-one map and we note

$$X^* = \Phi(X) \tag{7}$$

Then,

$$K := \overline{co}^*(X^*) \tag{8}$$

has the following properties:

a) K is weak* compact;
b) $K \equiv \operatorname{ext} K \subset X^*$;
c) $\emptyset \neq \operatorname{ext} K \subset X^*$;
d) $l_x \in \operatorname{ext} K \Leftrightarrow L_{1,x}(S_0) = \{\varepsilon_x\}$

Def. 2.1:

$$\partial_{Ch}(G) = \{x \in X | l_x \in \operatorname{ext} K\} \tag{9}$$

is called the Choquet boundary of G.
Then, we have:

Prop. 2.2: $S_0 \subset C(X)$ (as before) is a Korovkin set with respect to T iff

$$\partial_{Ch} G = X \tag{10}$$

where $G = < S_0 >$.

Def. 2.3: $x_0 \in X$ is a peak-point of G iff: $(\exists) g_1 \in G$ for which:

$$g_1(x_0) = \|g_1\|, |g_1(x)| < \|g_1\|, x \neq x_0 \tag{11}$$

$p(G) =$ the set of all peak-point of G.

For $p(G)$, we have the obvious inclusion:

$$p(G) \subseteq \partial_{Ch}(K) \tag{12}$$

Obs. 2.4:

a) If $p(G) = X$, then S_0 is called strict Korovkin set for T.

b) If $S_0 \subset C(X)$ is as before, then we have:

$$\partial_{Ch}(G) \subseteq p(\overline{G}) \tag{13}$$

Since $1_X \in S_0$, the conditions and constructions work for all the then cases T^+, T_1, T_1^+ and they are slightly different for general sets S.

Let $S \in C(X)$ an admissible set and G, G^*, X^* as before. The three cases are characterized by the existence of a real interval I ($I^+ = [0,\infty)$, for T^+; $I_1 = [-1,1]$, for T_1; $I_1^+ = [0,1]$, for T_1^+) with the property:

$$f(x) \in I, x \in X \Rightarrow \mu(f) \in I, (\forall)\mu \in L \tag{14}$$

Let:

$$I \times X^* = \{\lambda l \mid \lambda \in I, l \in X^*\} \tag{15}$$

and

$$K = \overline{co}^*(I \times X^*) \tag{16}$$

We can easily observe that:

$$K = \{l \in G^* \mid l(g) \in I, (\forall) g \in S \text{ with } g(x) \in I, x \in X\} = \{\mu|_G \mid \mu \in L(G)\} \tag{17}$$

In the case:

a) $T^+, K = K^+$ is the closed convex cone in G^* with the vertex in origin, spanned by X^*;

b) $T_1 : K = K_1$ is the closed unit ball of G^* ($\Leftrightarrow K_1 = \overline{co}^*(X^* \cup (-X^*))$);

c) $T_1^+ : K = K^+ \cap K_1 = \overline{co}^*(X^* \cup \{\theta\})$.

Theorem 2.5: If $S_0 \subset C(X)$ is an admissible set and the following properties hold:

a) $\rho_x \neq \rho_{x'}, x \neq x'$

$$(\rho_x = \{\lambda L_x | \lambda \geq 0\} \tag{18}$$

is called the ray generated by x in K^+);

b) $K^+ \cap (-K^+) = \{0\}$;

c) $(\forall) x \in X, \rho_x \in \text{ext}\, K^+$, then S is a Korovkin set with respect to T^+.

Corrolary 2.6: I. $S_0 \subset C(X)$ admissible set is a Korovkin set with respect to $T_1 \Leftrightarrow$

1) $X^* \cap (-X^*) = \varnothing$;

2) $\text{ext}\, K_1 = X^* \cup (-X^*)$.

II. $S_0 \subset C(X)$ admissible set is a Korovkin set with respect to $T_1^* \Leftrightarrow X^* \subset \text{ext}\, K_1^+$.

Sets no containing 1_X.

In this case, we consider the following definition:

Def. 2.7: If $S_0 \subset C(X)$,

$$\partial G = \{x \in X | L_x(G) = \{\varepsilon_x\}\} \tag{19}$$

is called the generalized Choquet boundary of G (or a simply boundary of G with respect to T).

If $1_X \notin S_0$, the def.2.3 is modified as well:

Def. 2.8: $x_0 \in X$ is called a peak point for G and class T iff $(\exists) g_0 \in G$ with the following properties:

(i) $g_0(x_0) = 0, g_0(x) > 0, x \neq x_0,$ (for T^+) (20)

$\big(\Updownarrow$
x_0 is a zero minimum point).

(ii) $|g_0(x_0)| = 1, g_0(x) < g_0(x_0), x \neq x_0,$ (for T_1) (21)

$\big(\Updownarrow$
x_0 is a positive maximum point).

(iii) $g_0(x_0) > 0, g_0(x) < g_0(x_0), x \neq x_0,$ (for T_1^+) (22)

$\Updownarrow$

x_0 is a positive maximum point).

If $1_X \in G$, the then definition of peak points coincide.

Def. 2.9: $x_0 \in X$ is called a quasi peak-point of G if:

$$\left[(\forall)\varepsilon > 0, (\forall)U \in V(x_o), (\exists)g_0 \in G_+ \text{ with}: g_0(x) \geq 1, x \in X \setminus U \text{ and } g_0(x) < \varepsilon\right] \quad (23)$$

$q(G) \equiv$ the set of all quasi-peak points.

Obviously,

$$p^+(G) \subseteq q^+(G) \subseteq \partial^+(G) \quad (24)$$

Prop. 2.10: If $S_0 \subset C(X)$ and G contains a strictly positive function, then:

$$\partial G = \partial^+ G = q^+(G) \subseteq \overline{p^+(G)} \quad (25)$$

and $q^+(G) \equiv q_1^+(G)$.

If $G \subset C(X)$ is no vanishing, then: $p_1^+(G) \subseteq q_1^+(G) \subseteq \partial_1^+(G)$.
More, if $\partial G = \partial^+ G = q^+(G)$ and $1_X \in G$, we have:

$$\partial_{Ch}(G) \subseteq \overline{p^+(G)} \quad (26)$$

Obs. 2.11: If $S_0 \subset C(X)$ separates the points of X, we have the following inclusion:

$$\partial_1(G) \subseteq \overline{p_1(G)} \quad (27)$$

Theorem 2.12: Each Cebîşev system S (with more than 3 functions) on $X = [a,b]$ is a Korovkin system and $[a,b] \subseteq p^+(S)$.

We can apply the results obtained above for finite sets of $C(X)$. Then, we obtain new results:

Theorem 2.13: Let $S = \{g_0, g_1, \ldots, g_n\} \subset C(X)$ an admissibile set. Then, we have:

a) S is a T^+- Korovkin set $\Leftrightarrow G$ contains a strictly positive function and X^* is an $(m+2)$- independent set.
(so: $(\forall)(m+3)$ distinct points of S in an $(m+2)$- dimensional subspace of R^{m+3}).

b) S is a T_1^+ Korovkin set $\Leftrightarrow X^*$ is an $(m+2)$ - convex – regulated.

($\Leftrightarrow \forall\,(m+3)$ distinct points of X^* in an $(m+2)$ - dimensional plane of R^{m+1}).

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INTERACTION ANALYSIS IN SUCCESSFUL TEAMS

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Abstract: *The paper insists on the fact that groups composed entirely of clever people, or of people with similar personalities, display negative results and lack creativities and describe the way in which one team member interacts with another where performance serves to facilitate the progress of the team as a whole.*

Keywords: *team, success, work, interaction.*

Members of a group must work well together as a team. Belbin concludes that groups composed entirely of clever people, or of people with similar personalities, display negative results and lack of creativity. He describes "team-role" as a pattern of behavior characteristic of the way in which one team member interacts with another where performance serves to facilitate the progress of the team as a whole. The eight types of people identified are:

- Type company worker/implementer (conservative, dutiful, predictable, disciplined) has positive qualities like organizing ability, practical common sense, hard-working, self-discipline. He also has allowable weaknesses like lack of flexibility and unresponsiveness to unproven ideas.
- Type chairman/co-ordintor (calm, self-confident, controlled) has positive qualities like a strong sense of objectives and a capacity for treating and welcoming all potential contributors on theirmerits and without prejudice. Also he has allowable weaknesses like no more than ordinary in terms of intellect or creative ability.
- Type shaper (challenging highly strung, outgoing, dynamic) has positive qualities like drive and a readness to challenge inertia, ineffectiveness, complacency or self-deception. He has also alloable weaknesses like proneness to provocation, irritation and impatience.
- Type plant (creative, individualistic, serious-minded, unorthodox) has positive qualities like genius, imagination, intellect, knowledge. He has also allowable weaknesses like up in the clouds, inclined to disregard practical details or protocol.
- Type resource-investigator (extroverted, enthusiastic, curious, communicative) has positive qualities like a capacity for contacting people and exploring anything new for good respond to challenge. He also has allowable weaknesses that liable to lose interest once the initial fascination has passed.
- Type monitor-evaluator (sober, unemotional, prudent, discerning) has like positive qualities: judgement, discretion, hard-headedness. He also has like allowable weaknesses lacks inspiration or the ability to motivate others.
- Type team-worker (diplomatic, socially, orientated, rather mild, sensitive) has positive qualities like an ability to respond to people and to situations and to promote team spirit. He also has allowable weaknesses like indecisiveness at moments of crisis.

- Type completer-finisher (painstaking, orderly, conscientious, anxious) has like positive qualities a capacity for follow-through and perfectionism. He also has like allowable weaknesses a tendency to worry about small things.

The most consistently successful teams were "mixed" with a balance of team roles. Experience suggests there is no other team-role that it would be useful to add. The role that a person undertakes in a group is not fixed and may change according to circumstances. Team-roles differ from what Belbin calls "functional-roles".

Later Belbin discusses the continued evolution of team-roles which now differ in earlier research with the addition of a ninth role, naimed "specialist".

- Type specialist (single-minded, self-sharing and dedicated) has like a positive qualities provides knowledge and skills in rare supply. He has like allowable weaknesses contributes on only a narrow front and dwells on technicalities.

In groups the behavior may be analysed from the viewpoint of its function. This approach has developed largely from the work of Bales on methods for study of small groups and indications of factors influencing the process. In Bales's "Interactions Process Analysis" every act of behavior is categorized as it occurs, under twelve headings which are:

1. Task functions (directed towards problem-solving: "production" activities behavior and evaluation/exchange of ideas and information).
2. Socio-emotional functions (maintenance functions) (concerned with the relationships among group members, giving encouragement and support, maintaining cohesiveness and the resolution of conflict).

An explanation of these categories is given in Table 1.

Bales gives 27 typical group roles which are based on various combinatins of these original main behavioral categories.

Table 1 The differentiate between "task" functions and socio-emotional functions

Socio-emotional: positive reactions	**Task: attempted answers**	**Task: questions**	**Socio-emotional: negative reactions**
Shows solidarity, raises "others" status gives help reward.	**Gives suggestion**, direction implying autonomy for other.	**Ask for orientation**, information, repetition, confirmation.	**Disagrees**, shows passive rejection, formality, withholds help.
Socio-emotional: positive reactions	**Task: attempted answers**	**Task: questions**	**Socio-emotional: negative reactions**
Shows tension release, jokes, langhs, shows satisfactions.	**Gives opinion**, evaluation, analysis, expresses feeling, wish.	**Asks for option**, evaluation, analysis, expression of feeling.	**Shows tension**, asks for help, withdraws out of field.
Agrees, shows passive acceptance, understands concurs, complies.	**Gives orientation**, information, repeats, clarifies, confirms.	**Ask for suggestions**, direction, possible ways of action.	**Shows antagonism**, deflates, others status, defends or asserts self.

Benne and Sheats classified member roles performed in well-functioning groups into three broad headings: group task roles, group maintenance roles and individual roles. An exploration of these categories is given in Table 2.

Table 2 The three broad headings of member roles

Group task roles	Maintenance roles	Individual roles
The initiator-contributor The information seeker The opinion seeker The information giver The opinion giver The elaborator The co-ordinator The orienter The evaluator-critic The energizer The procedural technician The recorder	The encourager The hermoniser The compromiser The gatekeeper and expediter The standard-setter or ego ideal The group observer and commentator The follower	The aggressor The blocker The recognition-seeker The self-confessor The playboy The dominator The help-seeker The special interest pleader

Groups are an essential feature in the life of the organization. The behavior in groups may be analyzed from the viewpoint of its functions process. Reactions to the value and effectiveness of groups is mixed. There are a number of potential benefits but some participants can find the experience disturbing and unpleasant.

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REDUCING ROLE CONFLICT AND ROLE STRESS

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Abstract: *The paper insists on the fact that groups are formed as a consequence of the pattern of organization structure and arrangements for the division of work. Goals are identified by management, and certain rules, relationships and norms of behavior are established.*

Keywords: *conflict, role, stress, organization*.

The concept of “role” is important to the functioning of groups and for an understanding of group processes and behavior. In order that the organization can achieve its goals and objectives, the work of individual members must be linked into coherent patterns of activities and relationships.

The “role” is an expected pattern of behaviors associated with members occupying a particular position within the structure of the organization.

Groups are formed as a consequence of the pattern of organization structure and arrangements for the division of work. Formal groups are created to achieve specific organizational objectives and are concerned with the co-ordination of work activities. Goals are identified by management, and certain rules, relationships and norms of behavior are established.

Groups are deliberately planned and created by management as part of the formal organization structure. But groups will also arise from social processes and the informal organization. It is a major distinction between formal and informal groups.

Informal groups are based more on personal relationships and agreement of group members that on defined role relationships. The membership of informal groups can cut across the formal structure. An informal group could also be the some as the formal group, or it might comprise a part only of the formal group (see Fig. 1).

The formal organizational relationship (line, functional, staff or lateral) can be seen as forms of role relationships.

The role/roles that the individual plays within the group is influenced by a combination of situational and personal factors. The role that a person plays in one work group way be quite different from the role that person plays in other work group.

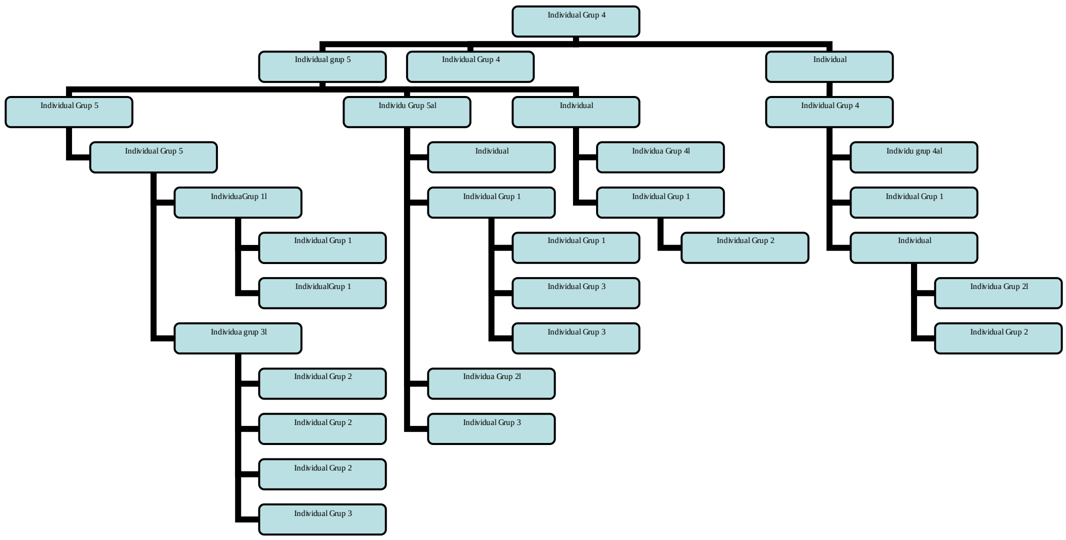

Fig1 Informal group structure of an organization

The individual will have in addition to the role relationships with members of their own group (peers, superiors, subordinates), a member of role – related relationships with outsiders, for example members of other work groups trade union officials, suppliers, consumers. The "role-set" comprises the range of associations or contracts with whom the individual has meaningful interactions in connection with the performance of their role.

In practice, the manure in which a person actually behaves way not be consistent with their expected pattern of behaviors. This inconsistency may be result of role conflict. As a generic term, role conflict includes:

- role incompatibility, (compliance with one set of expectations makes it difficult or impossible to comply with other expectations, because the two role are in conflict; a typical example might be the situation of a manager who believes in a relaxed, participative style of behavior, but whose superior believes in a Theory X approach and expects the manager to adopt a more formal and directive style of behavior);
- role ambiguity (the situation that the person's own perception of their role may differ from the expectation s of others; this implies that insufficient information is available for the adequate performance of the role, which way result from a lack of formally prescribed expectations);
- role overload (this leads to a conflict of priority, which is seen in terms of the total role-set, and implies that the person has too many separate roles to handle);
- role underload (the situation when the prescribed role expectations fall short of he person's own perception of their role; that is for example, when a new member of staff is first appointed, or from the initial effects of delegation).

Role conflict can result in role stress, which is a major influence on job satisfaction and work performance. Greater attention is now given to health problems that are classified as stress-related. Decreasing efficiency resulting from work stress is also extremely costly to organizations. The managers must make every effort to minimize the causes of stress.

The ways in which management might attempt to reduce role conlict and the possibilities of role stress are:

- giving advance notice and explanation of what is likely to happen;
- review of organization structure, information flow and communication networks;
- the creation of new roles or assimilation of existing roles, plus the clarification of priorities and the elimination or downgrading of minor roles;
- change in management system and leadership style;
- medical examinations and health screening to give early indications of potential stress-related problems;
- attention to factors which may help improve group structure and group cohesiveness, and help overcome inter-group conflict;
- attention to induction and socialization programmes job training and retraining, staff development and career progression plans;
- improved recruitment and selection and the careful matching of abilities, motivation, interests and personalities to the demands of a particular role;
- increase specification and clarity of prescribed role expectations.

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THE RISK MANAGEMENT AND THE FINANCIAL STABILITY

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Abstract: *The notable growth of goods and services flow, doubled by that of the cash flow, has emphasized the financial and economic integration at global level, this taking place simultaneously and in parallel with the unprecedented diversification of the financial – monetary structures. The realities brought about by the globalization dictate clear and final solutions that, in order to be efficient, have to start from the necessity of having actions thought about at least at regional level. In order to obtain real positive effects, the strategies have to surpass the national domain and the decisions have to be based upon common interests and upon an efficient collaboration in the domain of the macro-economic policies, oriented towards the promotion of a non-inflationary and durable growth, stable from the financial and economic point of view.*

Keywords: *risk, stability, management, finance.*

The financial stability like a concept is not precisely evaluated, but a financial system is considered stable when it has the capability to administrate economic resources and financial risks when necessary, to correct the external-economic shocks.

We appreciated that a financial system in its complexity is stable when it has the capability to perform and to correct the unbalance that appears into an economic system.

The considerable growth of goods and services flows and also the capital flows determined the economic and financial integration in the global economy. The product and sales of bulk carriers in the greatest shipyards from some countries in EU represented for the financial system an important level in 2006-2007.

The economic, monetary and financial environment must suffer internal changes of external influence and a strong competition.

This process gives new chances and opportunities, but also challenges associated with the risks of possible consequences.

Together with the growth of capital mobility and the freedom of financial flows (year 1990), the capital market is developed in all its complexity.

In the same time the approach to administration of liquidity and risks represent a great diversity. The relationships between different market segments have as a result the existence of a wholesale market of liquidity. The effect consists in the possibility to disperse the risks and to obtain liquidity at reasonable costs.

The financial fragility of a ship society can be dissimulated by the structures of financial market. In the periods with the great tensions (because of macro-economic and structural shocks), financial perturbation was produced and that perturbation transmitted a feedback in the market structure. Taking into account these circumstances the perturbation is transmitted from market to market.

The incertitude that affects the financial domain is divided into two directions:

- ◊ *The first type proceeds from the relation between markets and it is named ethical incertitude;*
- ◊ *The second type proceeds from future that is unknown and it is named epistemology incertitude.*

In the moments of incertitude in order to insure the performance on short term, the funds administration receipts the signal and induces massive actions of sales or buy of actives.

For the financial market there are two hypotheses about the systemic risk:

- *Unsymmetrical information about the capital market1 that determines an undervaluation of the risks and determines a financial fragility following by a strong growth of financial intermediate costs and constrained diminish of credit;*

- *The assets evaluation under the pressure of liquidity risk2 leads to a panic and contagious behavior, caused by market actors.*

This hypothesis shows the reality that the finances consist in a correct reception of market information. This is explained because the liquidity risks are at the origin of the systemic risk. In the economic systems with strict settlements for controlling the risk there were introduced new compulsions that limit the free competition and authorize the funds administrations to introduce prohibitive commissions.

The globalization imposes regional and clear solutions to be efficiently. To obtain a positive effect, the strategies must be based on common interests and an efficient collaboration in the domain of macro-economical policies.

Economic analysts sustain the necessity of a flow system control as a solution to diminish and protect the national economy.

For a stable economy is very important the state control on the capital flow. The Central Bank and public authority depend on international capital flow and from reaction of internal market.

There are three models for supervising the financial sector:

1) *Institutional Model where the controlling authority* is in charge with the supervising of some financial Institutes. In most of the countries the Central Bank has authority control on the other banks and another authority administration the institution of capital market.

2) *Functional Model*, that says that every authority must survey a specific type of activity.

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[1] F. Mishkin (1995) – "Asymmetric Information and Financial Crises: a Historical Perspective" în Ed. P. Hubbard, *Financial Markets and Financial Crises,* Chicago University Press.

[2] H. Minsky (1986) – *Stabilizing and Unstable Economy,* Yale University Press.

3) *Integrate Supervising Model*, this model underlines the necessity of the existence of one agency that is in charge with the supervision of the financial sector on the whole (financial-banking, insurance societies, capital market). This model is due to the globalization of economic systems.

The advantage of this model is:

- Gives a complete image of the risk at global level;
- Eliminates the superposition in direction of supervision;
- Develops services for information and risk analyze.

As an alternative of this system is to build a Model of Cooperation between the Surveillance Authority. It consists in offering in reciprocity the access to all specific information. In time an Authority Surveillance Council can be set up, that has the mission to favor the exchange of information between all the surveillance of economic system.

A critical idea is that the control is responding at the market malfunction and another solution is necessary for a stable economy3.

The control is seen like an instrument for public authority and a *way to administrate the capital expansion and financial crises*.

The efficient measures depend on a good identification of structure economic problems, of possible risk in the affair development.

The general evolutions of the world system during the last decades, associated with the most recent events that mark the year 2006, in the context of the role played by the USA in the present-day global system, determine some analysts to announce the imminent outbreak of a global systemic crisis: the major crises in most countries worldwide, the commercial and the payment balance deficits; continuous depreciation of the American dollar, etc. One considers that finance is one of the domains most likely to be affected by the impending global systemic crisis. The acceleration and accumulation of negative phenomena determine systemically global crises4 and affect the international trade, financial system, rate of change and energy system (petroleum and gas resources), etc.

The most important signals that show the beginning of financial system crises are:

- The fall down of assets in American dollars - for example, in less than one year the value of international assets in American dollars by opposite to the monetary basket of most important commercial partners of USA, diminished with 2.000 billion USD, just because of continuous depreciation of the dollar;
- Public debt monetization of the USA, that strongly affects the balance sheet of the greatest financial operators;
- The quickly fall down of USA bank balance sheet and also for some important banks from EU, together with the reduce of banking reserve;
- The continuous American economic regress.

[3] Dooley M.P. 1995 – A Survey of Academic Literature on Controls over International Capital Transactions, IMF Working Paper, WP/95/127, novembre
[4] Communiqué public du GlobalEurope Anticipation Bulletin N°10 / 15 décembre 2006

CONCLUSIONS

The finances ministers of the G7 group give a warning about the problems inside the international finances and show that for the moment there is no measure to lead to a greater stability without important economic costs.

The main solutions derive from the considerable accentuation of the financial integration and they impose:

- the necessity of closer international cooperation in order to regulate and supervise/control the financial institutions and markets, this being vital for the rescue of the financial system and for the respect of the prudential norms;
- the maintenance of healthy macro-economic policies that can offer the necessary conditions for a non-inflationary and durable growth, in order to insure the stability and to prevent the appearance of internal or external imbalances;
- a real cooperation in the domain of economic policies that aims at common objectives regarding the fight against inflation and also at the reduction of public deficits, at the diminution of the external imbalances, at having stable exchange rates and low long-term rates of interest;
- the awareness of the responsibility of each state or group of states in promoting a stable and efficient monetary system, regarding the putting into practice of measures meant to strengthen the capacity of risk management and of preventing any crisis and also of improving the answers when a crisis appears.

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FLEXIBILITY - PART OF FITNESS

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Abstract: *Flexibility – physical quality necessary in training of military students. The stretching exercises described in this paper are efficient for fighting stress, if they are performed with patience and slowly until acquiring a blood pressure that confers the wanted effect.*

Keywords: *fitness, exercise, flexibility.*

1 INTRODUCTION

What is flexibility and why is it important?

We can describe flexibility as the range of motion of a joint and the muscles and tendons surrounding that joint area. Flexibility is a component of fitness that is often neglected in the total fitness picture, which includes cardio-respiratory endurance, body composition, flexibility, muscular strength and muscular endurance. Good flexibility improves the military student's ability to accomplish physical tasks and probably lowers the risk of injury or strain. A well-planned physical training program including both strength and flexibility exercises will improve a military student's resistance to injury and make muscles and tendons more elastic and less likely to tear under stress. Military student's tasks such as lifting, loading, climbing, parachuting an d rappelling require an adequate level of flexibility and strength to perform them successfully without injury.

How is flexibility assessed?

No single test can assess total body flexibility, but a sit and reach or floor touch test can assess hamstring and low back flexibility. These areas are related to the military student's skills and commonly susceptible to strain.

Military students who fail to reach past their toes in either sit and reach assessment should work daily on flexibility improvement by performing stretching during warm-up and cool-down periods, and spending time on flexibility improvement techniques.

2 PROPER WARM-UP AND COOL-DOWN PROCEDURES

Warm-up

Before beginning any vigorous physical activity, you should gradually prepare the body to avoid muscle temperature, circulation, blood pressure, joint range of motion and neuromuscular-pattern preparation. The following is a proper sequence of warm-up activities to be performed for 5 to 7 minutes, prior to vigorous exercise:

1. Slow, double-time in place for 1 to 2 minutes. This will cause a gradual increase in heart rate, blood pressure, circulation, and muscle temperature.
2. Slow joint rotation exercises (arm circles, knee/ ankle rotations) to gradually increase joint range of motion. Rotation exercises should be performed for 5-10 seconds at each joint.
3. Stretching the muscles to be used for the upcoming activity. Slow, static stretching will "loosen out" muscles and tendons and enable them to achieve greater ranges of motion with less chance of injury. Hold stretch positions for 10 to 15 seconds. Avoid bouncing or bobbing movements.
4. Slow mimicking of the activities to be performed (shadow boxing for the boxer, lifting a lighter weight to warm-up for the heavier one, swinging a golf club a few times before hitting the ball). This allows for neuromuscular preparation for the upcoming activities

Cool - Down

Stopping suddenly after vigorous exercise can be very dangerous, even fatal. You should gradually decrease your activity to bring the body back to its resting state. The following is a proper sequence of cool-down activities:

1. Don't suddenly stop – slow the activity down (walk 1 to 2 minutes after running). The body has limited blood supply. Adequate blood flow to the brain and heart must be maintained, while large quantities are being pumped to pool in those muscles and restrict adequate quantities to the heart and brain. This may result in fainting, heart attack or stroke.
2. Repeat the stretches done in the warm-up to ease muscle tension are very warm from the previous activity.

Factors affecting an individual's flexibility

1. genetic endowment
2. age
3. sex
4. temperature/ circulation
5. activity vs inactivity
6. injury

Types of stretching exercises

The following are four types of stretching exercises for flexibility improvement, warm-up and cool-down. All are helpful in improving flexibility, but some are safer than others in relationship to injury potential.

1. Ballistic stretching

   This type of stretching involves bouncing or bobbing to obtain a greater range of motion or stretch position. Although this method of stretching may improve flexibility, the exerciser may force a stretch too far and cause injury. We do not recommend this type of stretching.

2. Passive stretching

Relying on a partner or equipment to aid in stretching may insure a safe stretch at a range of motion that could not be obtained alone. Be careful not to overstretch. Communication between partners will reduce the chance of injury.

3. Proprioceptive neuromuscular facilitation (PNF)

   PNF stretching trains neuromuscular patterns to aid in flexibility improvement. A series of stretches, isometric contractions and relaxations are performed with the aid of a partner or equipment to relax the muscle and allow it to reach greater ranges of motion.

4. Static or gradual stretching

   Assuming stretch position slowly until tension or tightness, not pain, is felt and then holding for 10 seconds or more is desired over bouncing over bouncing or jerking movements to enhance flexibility and reduce incidence of injury. Holding a stretch position allows the muscle to this new length. This type of stretching should not be painful. You may feel slight discomfort, but acute pain is a signal that you may have stretched too far.

3 FLEXIBILITY EXERCISE PRESCRIPTIONS (PLANNING A PROGRAM)

Flexibility exercises should be included in all physical fitness programs. The FITT guideline should be followed.

Frequency – Daily, during warm-up and cool-down

Intensity – Tension or slight discomfort, NOT PAIN

Type – Stretches that are assumed slowly and gradually

Time – 10 seconds to 2 minutes

- 10-15 seconds for warm-up/ cool-down
- 30 seconds or longer for flexibility improvement

The following illustrations demonstrate stretching exercises that will safely improve flexibility if performed slowly with gradual progression on a regular basis.

* SPECIAL NOTE: As in any physical activity program, consult a physician before engaging in exercise. Some exercises may be too difficult or strenuous for unfit or medically limited individuals.

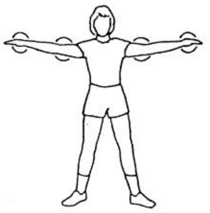
Individual static stretching. Assume all stretch positions slowly until tension or slight discomfort is felt. Hold all stretch positions for 10-15 seconds for warm-up and cool-down. Developmental stretching for flexibility improvement requires holding each stretch for 30 seconds or longer. Select stretching exercises from the following illustrations for the muscles groups appropriate to your needs.

NECK

Position: Stand with the back straight and feet shoulder width apart; place the hands on the hips.

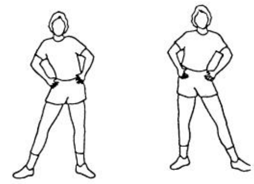
Action: Roll the head slowly to the left, making a complet with the path of the head. Do three times in each dire

ARMS AND SHOULDERS



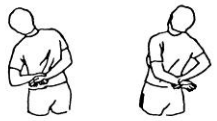
Position: Stand with the back straight and feet shoulder width apart. Extend the arms outward to shoulder height.
Action: Rotate the shoulders forward, making a large circular motion with the arms. Repeat the action in the opposite tion. Do three times in each direction.

HIPS



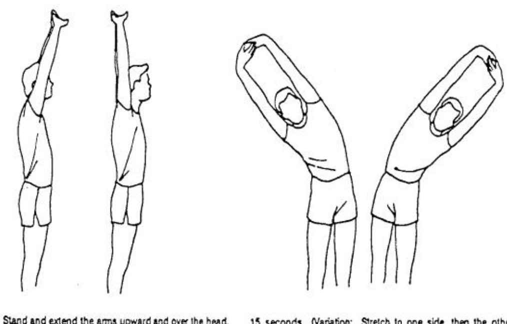
Position: Stand in the same manner as for the neck rotation.
Action: Rotate the hips clockwise while keeping the back straight. Repeat the action in a counterclockwise direction. Do three times in each direction.

NECK AND SHOULDER STRETCH



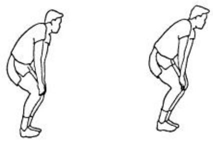
Position: Stand with the arms behind the body.
Action: Grasp the left wrist with the right hand. Pull the left arm down and to the right. Tilt the head to the right. Hold for 10 to 15 seconds. Repeat the action with the right wrist, pulling the right arm to the left. Tilt the head to the left. This stretches the sternocleidomastoid, pectoralis major, and deltoid muscles.

ABDOMINAL STRETCH



Position: Stand and extend the arms upward and over the head. Interlace the fingers with the palms turned upward.
Action: Stretch the arms up and slightly back. Hold for 10 to 15 seconds (Variation: Stretch to one side, then the other. Return to the starting position. This stretches the rectus abdominus muscles.

KNEES AND ANKLES

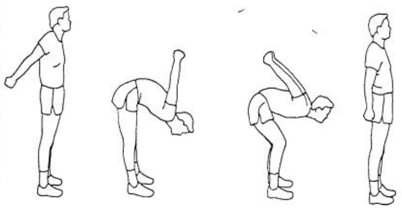


Position: Stand with the feet together, bending at the waist with the knees slightly bent.
Action: Place the hands on the knees and rotate the legs in a clockwise direction. Repeat the action in a counterclockwise direction. Do three times in each direction.

INDIVIDUAL STATIC STRETCHES

Assume all stretching positions slowly until tension or slight discomfort is felt. Hold each position for 10 to 15 seconds during the warm-up and cool-down. Developmental stretching to improve flexibility requires holding each stretch for 30 seconds or longer. Choose from the following stretching exercises for the muscle groups you need to work on.

CHEST STRETCH

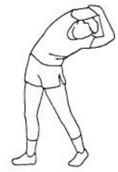


Position: Stand, and interlace the fingers behind the back.
Action: Lift the arms behind the back so that they move outward and away from the body. Lean forward from the waist. Hold for 10 to 15 seconds. Bend the knees before moving to the upright position. Return to the starting position. This stretches the pectoralis major muscle group.

UPPER-BACK STRETCH

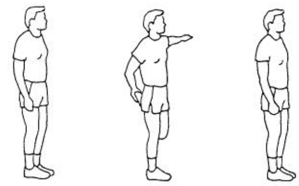
Position: Stand with the arms extended to the front at shoulder height with the fingers interlaced and palms facing outward.
Action: Extend the arms and shoulders forward. Hold for 10 to 15 seconds. Return to the starting position. This stretches the lower trapezius, posterior deltoid, rhomboids, teres major and minor, and the upper part of the latissimus dorsi muscles of the upper back.

OVERHEAD ARM PULL



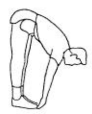
Position: Stand with the feet shoulder width apart. Raise the right arm, bending the right elbow and touching the right hand to the back of the neck.
Action: Grab the right elbow with the left hand and pull to the left. Hold for 10 to 15 seconds. Return to the starting position. Then do the same stretch, pulling the left elbow with the right hand for 10 to 15 seconds. This stretches the external and internal obliques, serratus anterior, latissimus dorsi, triceps, and hip abductors (tensor facia lata muscles).

THIGH STRETCH



Position: Stand. (For variation, lie on the stomach.)
Action: Bend the left leg up toward the buttocks. Grasp the left foot with the right hand, and pull the heel toward the buttocks. Extend the left arm to the side for balance. Hold for 10 to 15 seconds. Return to the starting position. Bend the right leg and grasp the right foot with the left hand. Extend the right arm for balance. Hold for 10 to 15 seconds. Return to the starting position. This stretches the quadriceps and hip flexors (iliopsoas muscles).

HAMSTRING STRETCH (STANDING)



Position: Stand with the knees slightly bent.
Action: Bend forward keeping the head up, and reach toward the toes. Straighten the legs and hold this position for 10 to 15 seconds. This stretches the hamstrings, erector spinae, and gluteus maximus muscles.

HAMSTRING STRETCH (SEATED)

Position: Sit on the ground with both legs straight and extended forward with the feet upright about six inches apart. Put the hands on the ankles or toes.
Action: Bend from the hips, keeping the back and head in a comfortable, straight line. Hold for 10 to 15 seconds. (Variation for greater stretch: stretch and pull back on the toes.) In addition to the muscles mentioned in the standing hamstring stretch, this stretches the calf (gastrocnemius and soleus) muscles.

GROIN STRETCH (STANDING)

Position: Lunge slowly to the left while keeping the right leg straight and the right foot facing straight ahead.
Action: Lean over the left leg while stretching the right groin muscles. Hold for 10 to 15 seconds. Repeat with the opposite leg. This stretches the hip adductor muscles.

GROIN STRETCH (SEATED)

Position: Sit on the ground with the soles together and placed close to the torso. Hold the toes with the hands.
Action: Bend forward from the hips, keeping the head up. Hold for 10 to 15 seconds. This stretches the hip adductor and erector spinae muscles.

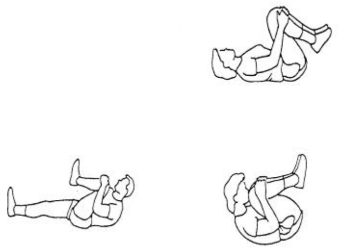
CALF STRETCH (VARIATION: TOE PULL)

Position: Stand with the feet shoulder width apart.
Action: Bend forward at the waist and hips. Slightly bend the right knee and fully extend the left leg. Reach down and pull the toes of the left foot toward the left shin. Hold for 10 to 15 seconds. Return to the starting position; then pull the toes of the right foot for 10 to 15 seconds. This stretches the calf (gastrocnemius), and to a lesser extent, the hamstrings, gluteus maximus, and erector spinae muscles.

HIP AND BACK STRETCH (SEATED)

Position: Sit on the ground with the right leg forward and straight. Cross the left leg over the right while sitting erect. Keep the heels of both feet in contact with the ground.
Action: Slowly rotate the upper body to the left and look over the left shoulder. Reach across the left leg with the right arm and push the left leg to your right. Use the left hand for support by placing it on the ground. Hold for 10 to 15 seconds; then repeat this stretch for the other side by crossing and turning in the opposite direction. This stretches the hip abductors, erector spinae, latissimus dorsi, and oblique muscle groups.

HIP AND BACK STRETCH (LYING DOWN)



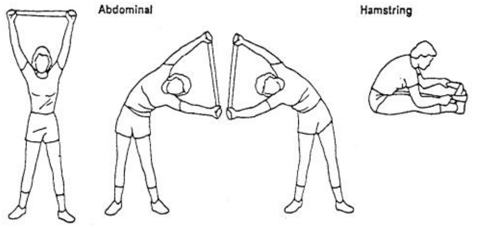
Position: Lie on the back with the arms straight beside the body. Keep the legs straight and the knees and feet together.
Action 1: Bring the left leg straight back toward the head, leaving the right leg in the starting position. Bring the head and arms up; grab the bent left leg behind the knee and pull it gradually to the chest. Flex the left foot and toes toward the knee. Hold for 10 to 15 seconds. Gradually return to the starting position. Bring the arms up; grab the bent right leg behind the knee and pull it gradually to the chest. Flex the right foot and toes toward the knee. Hold for 10 to 15 seconds. Gradually return to the starting position. This stretches the gluteus maximus and erector spinae muscles.
Action 2: Pull both knees to the chest. Keep the upper body flat on the ground. Pull the head up to the knees. Hold for 10 to 15 seconds. Return to the starting position. This stretches the same muscles mentioned for action 1.

PASSIVE STRETCHES

Passive stretching is done with the help of a partner or equipment. These examples show passive stretching using a towel, both alone and with a partner.

The partner gradually applies light pressure to help the exerciser until he reaches the hold point. The partner talks to the exerciser to ensure he is not applying too much pressure.

TOWEL STRETCHES



CHEST STRETCH

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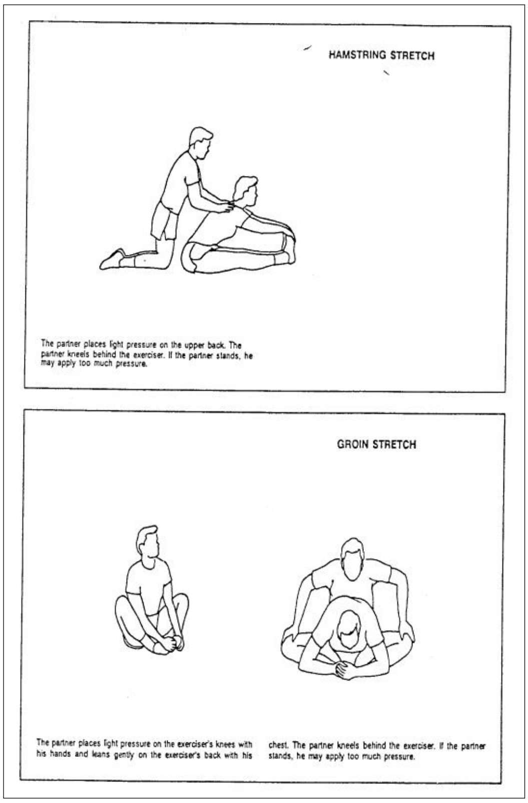
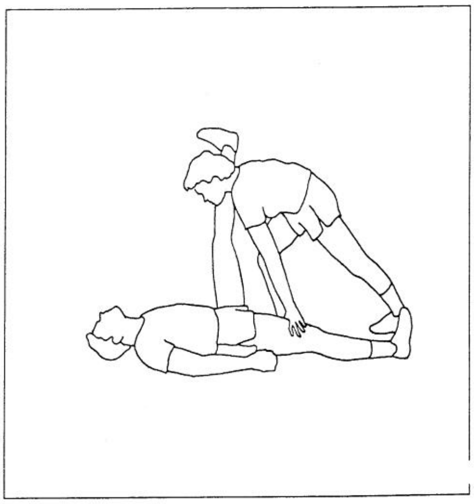


HAMSTRING STRETCH

The partner places light pressure on the upper back. The partner kneels behind the exerciser. If the partner stands, he may apply too much pressure.

GROIN STRETCH

The partner places light pressure on the exerciser's knees with his hands and leans gently on the exerciser's back with his chest. The partner kneels behind the exerciser. If the partner stands, he may apply too much pressure.



PNF STRETCHES

Soldiers can do this type of stretching for most major muscle groups. The exercise shown stretches the gluteal, hamstring, and gastrocnemius/soleus muscle groups. It uses a series of contractions against a partner's resistance, and relaxations. Obtaining a safe stretch beyond the muscle's normal length requires a partner's assistance. Both the exerciser and partner should follow these instructions:

1. Assume the stretch position slowly with the partner's help.
2. Isometrically contract the muscles in the rear of the leg (i.e., the muscles to be stretched). In this case, contract the gluteal, hamstring, and gastrocnemius and soleus muscles. Hold for 5 to 10 seconds against the partner's resistance.
3. Relax. Then isometrically contract the antagonists (the iliopsoas, quadricep, and tibialis anterior muscles). Hold for 5 to 10 seconds while the partner assists with a further stretch.
4. Repeat this sequence three times, then perform the same action with the opposite leg. (Caution: Breathe out during each contraction. Do not hold your breath.)

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ENERGY METABOLISM AND SWIMMING PERFORMANCE

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Abstract: *Swimming from one end of a pool to the other is made possible by the contractions of muscles. Muscular contraction, in turn, is achieved through the release of energy stored in chemical compounds within the body. Energy provides the power for swimming; without energy, muscles could not contract. This chapter describes the physiological mechanisms that provide energy for muscular contraction. The totality of the processes of supplying energy is called metabolism.*

Keywords: *swimmer, energy, performance, body.*

1 INTRODUCTION

During the past two decades, information about energy metabolism has been largely responsible for improvements in training methods, and it is therefore important that serious students of training understand the metabolic process.

Now we begin with a description of energy and proceeds to a discussion of the physiological mechanisms that make it available to the muscles for contraction.

2 ENERGY AND ITS SOURCES

Energy is usually defined as the capacity to do work. The ultimate source of our energy is the sun which radiates energy to the earth. When that energy strikes plants, it is transferred to them and stored as chemical energy through photosynthesis. When we eat these plants or the flesh of animals that have eaten them, we take the energy into our bodies and store it for later use. Energy is stored in plants and animals as carbohydrates, fats, and proteins.

We also store energy in our bodies in combination with certain chemicals. We transform the chemical energy to electrical energy for the transmission of nerve impulses and 10 mechanical energy for powering the work of muscular. *The speed of sprinters and the ability of middle-distance swimmers and I shimmers to maintain a certain pace are determined by the body's release chemical energy and transform it into mechanical energy.*

Because energy availability is the factor that governs the speed swimmers, the purpose of training should be to make more energy available to tin muscles at faster rates. Training does this through a process called adaptation. When swimmers continually expend large amounts of energy at rapid rates during training, their body stores more substances that contain energy and releases it more rapidly when it is needed during races. In other words, the body's physiological mechanisms adapt to the specific demands that are placed on them so that more energy is available to perform more work with less fatigue. A calorie is a measure of energy, and the caloric content of foods indicates the amount of energy we receive from them. A kilocalorie contains 1,000 calories. The term Calorie, with a capital "C." is a method for expressing a kilocalorie; calorie, with a lowercase "c." identifies the smaller calorie units. One thousand calories is equal to one Calorie (or one kilocalorie), which is equal to 426.85 kg/m of work (3,087.4 ft/lb).

3 STORAGE FORMS OF ENERGY IN THE BODY

Energy is stored in our bodies in combination with the following chemical subs: *adenosine in phosphate (ATP), creating phosphate (CP), carbohydrates, falt,* and *proteins.* All of these substances are formed by combinations of chemical muscles.

Triphosphate (ATP) consists of a protein molecule - adenosine - and three molecules of phosphate. Figure l-l illustrates the chemical structure of ATP. The diamond-shaped symbols connecting the four components represent energy. That energy binds the loran smaller molecules together to form the larger ATP molecule. The bonds between these molecules are sources of chemical energy waiting to be used.

ATP is the only source of energy in the body that can be used for muscular contraction. All the other energy-containing chemicals are used to recycle ATP contain amounts of ATP that are so small that they can be depleted in **« first few** seconds of exercise. Because ATP cannot be supplied to working muscle fibers from other parts of the body, it must be recycled immediately by other sources of energy stored inside those same muscle fibers. These sources are the remaining four chemicals: creatine phosphate (CP). carbohydrates, fats, and proteins. Enzymes begin breaking these substances down immediately at the onset of exercise so that their energy will be instantly available for recycling ATP. They recycle ATP at different rates of speed, however, the rate being largely determined by the number of intermediate steps they must undergo before their energy is released. The following ranking reflects their rates for recycling ATP:

a) Creatine phosphate
b) Carbohydrates
c) Fats and proteins

a) Creatine Phosphate (CP)

This chemical provides the most rapid source of energy for ATP recycling. As its name implies, it is composed of one molecule of creatin and one of phosphate. The molecules are bound together by energy (see Figure 1-21.

Unfortunately, the amount of CP that can be stored in the muscles is also quite small, only enough to maintain muscular contraction for about 10 to 15 seconds of all-out effort (Gollnick & Hermansen. 1973). After that, the CP supply is nearly depleted and the muscles must get the energy and phosphate they need to recycle ATP from carbohydrates, fats, and proteins.

b) Carbohydrates

These foods are made up of simple sugars and starches, which supply the energy for all body functions, including thinking and exercise. Glucose is the simple sugar that is used for ATP recycling. Foods that contain simple and complex sugars and starches are reduced to glucose during the digestive process and enter the bloodstream, where they are carried to the cells of the body.

Muscle Glycogen Glucose that enters muscle cells is stored there as glycogen. Muscle glycogen consists of a chain of glucose molecules.

When exercise begins, the glycogen stored in muscles is converted back to glucose. That glucose is then metabolized in a long and complex chain of events termed *glycol sis.* Energy for ATP recycling is released at several points along the chain. The energy from muscle glycogen can be made available more rapidly than other carbohydrate forms because it is stored in the muscles and does not need to be transported to them. Consequently, muscle glycogen is the primary source of energy for ATP recycling in all but the very shortest swimming events. It is also the next fastest source for ATP recycling after CP.

Liver Glycogen and Blood Glucose The blood and liver also contain supplies of glucose that can be mobilized and transported to the muscles when needed for energy. Blood glucose is more commonly called *blood sugar.* It is glucose that is poured into the blood from the stomach during the digestion of foods. At rest, it is transported to the muscles and the liver, where it is stored as glycogen. When swimmers are training, glucose that was circulating in the blood can diffuse into the muscle cells and enter the metabolic process without first being converted to glycogen.

The glucose that enters the liver is stored as glycogen. Liver glycogen must be converted back to glucose before it can be transported to the muscles and used to supplement their glycogen supply, however. Another important function of liver glycogen is to maintain an adequate blood glucose supply to the brain and other nervous tissues. Nerve cells, like other cells in the body, use glucose for energy, but. Unlike muscles cells, they cannot store it as glycogen. Therefore, they need a constant supply via the circulation.

Blood glucose and liver glycogen play almost no role in supplying energy during competition. The rate of speed called for in swimming races is so fast that the muscles must rely almost entirely on muscle glycogen for ATP recycling.

Liver glycogen and blood glucose can supplement muscle glycogen during endurance exercise, although they cannot replace the latter substance entirely. The process of converting liver glycogen to blood glucose and transporting it to die muscles is too slow to provide all of the energy for ATP recycling at fast, or even moderate, swimming speeds. So both liver glycogen and blood glucose can serve only as supplements, not substitutes, for muscle glycogen. Nevertheless, the role they play is very important because they allow swimmers to do more work before muscle glycogen becomes depleted.

Both blood glucose and liver glycogen play another important role by replacing muscle glycogen during the recovery period following exercise. This allows swimmers to replace this energy source between training sessions.

c) Fats and Proteins

C1. Fats are also an important source of energy for ATP recycling during exercise. One gram of fat contains more than twice the energy of an equal quantity of carbohydrate. Nevertheless, carbohydrates are the preferred fuel during exercise because the release of energy from fat is a slow process and it cannot replace ATP fast enough to sustain anything but slow to moderate swimming speeds.

As mentioned, fat can only be metabolized aerobically, and this process involves additional transport time from its storage depots — adipose tissue —to muscles, where it must enter Krebs cycle before it can be metabolized for energy. Thus, although the oxidation of fatty acids supplies abundant energy, it is if this were the only source, or even the primary source, for ATP recycling. Consequently, energy from fat can supplement, but cannot replace, glycogen as a source for ATP recycling during training.

The rate of fat metabolism in slow-twitch muscle fibers has been estimated to be ten times greater than in their fast-twitch counterparts. Consequently distance swimmers, who generally have a higher percentage of slow-twitch fibers, burn more fat (and less muscle glycogen) for energy during training. Thus, it may take longer for distance swimmers to deplete their muscle glycogen supply. This may be one reason why they seem to tolerate training better than sprinters.

C2. Proteins are synonymous with strength because they are the basic structural element of muscles. They are also one of the most important buffers in the body. Accordingly, they play a role in regulating the balance between acidity and alkalinity of body fluids — acid-base balance —during exercise.

In addition to their other functions, proteins can donate small amounts of energy for recycling ATP during exercise

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THE IMPACT OF OUTDOOR PLAY ACTIVITIES IN PRE-PRIMARY SCHOOL CHILDREN

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Abstract: *The present study explored how a natural environment in Norway provides a stimulating plays cape for kindergarten children, and how different features in the landscape a afforded play activities. The impact of such outdoor activities on children's motor fitness was tested, and a better improvement was found in the experimental group compared to the reference group. The study indicated a probable relation between all-round play in the natural environment and the effect on motor development in the children.*

Keywords: *children, Norway, impact, outdoor play.*

1 INTRODUCTION

Several kindergartens in the Scandinavian countries have experienced positive results from being outdoors in natural environments, but only a few studies have been done in the field (Bang et al., 1989; Fjortoft, 1999; Grahn et al., 1997).

We know far too little about how the natural environment functions as a playground for children, and we know even less about what effects such a playground might have on learning in children. The physical outdoor environment, and the natural environment in particular, as a play habitat for children, has been a topic of low priority in child research (Bjerke, 1994)

2 OBJECTIVES

The notion that versatile play in a natural environment might have an impact on children's development constituted the background for the present study. The aim of the study was to investigate how children's playing in the natural environment might stimulate their motor fitness and it was decided to focus on the affordances of the landscape and the correlation for versatile play. The main objectives were: to examine the impact of outdoor play activities in children's motor ability and mastering.

3 METHODS

An experimental study was carried out with 5 to 7 years old children in kindergartens in Telemark, Norway. Because of the lack of randomization, the study might be characterized as quasi-experimental approach. The groups were selected from three kindergartens equal in age groups (in 2000 with pedagogical practice courses occasion). The experimental group of 46 children from one kindergarten was offered free play and versatile activities in the forest next to the kindergarten.

The experimental group used the forest every day for 1-2 hours throughout the year when the attended the kindergarten. Only randomly they used outdoor playground inside the kindergarten fence. As reference group 29 children of the same age groups from kindergartens in the neighboring district were chosen. The groups were checked out for differences in socio-economic living conditions by the multiple regression analyses, using parents' educational and professional background as variables. The reference group used their traditional outdoor playground for 1-2 hours a day and visited natural sites only occasionally.

Both groups had the same standard playground equipment, such as sandpit, a swing, a seesaw, a slide and a climbing house in their outdoor playground. The treatment period lasted for 2 month. Both groups were tested with EUROFIT: European test of Physical Fitness, the Motor Fitness test. The test included the following test items: Flamingo balance test (standing on one foot) for testing of general balance; Plate tapping (rapid tapping of two plates alternatively with preferred hand) measuring the speed of limb movement. Sit and reach expressed flexibility in knee and thigh joints.

Standing broad jump (jumping for distance from a standing start) measured explosive strength. Sit-ups (maximum numbers of sit-ups achievable in half a minute) measured trunk strength. Bent arm hang (maintaining a bent arm position while hanging from a bar) for testing of functional strength in arm and shoulder, and Shuttle run (a running and turning, shuttle, test at maximum speed) testing running speed and agility. Two additional tests were introduced: Beam walking for testing dynamic balance and Indian skip (clapping right knee with left hand and vice versa), which tested cross coordination.

4 THE STUDY AREA

The site of the investigation was a small forest of 7.7 hectares of mixed woodland vegetation, located close to a kindergarten in Telemark County in Norway. The landscape pattern showed a mosaic of patches of woodland with some open spaces of rocks and open fields and meadows in between. Vegetation and topography jointly afforded a diversity of play habitats for the children. The children's favorite places were named "The Cone War", "The Space Ship" and "The Cliff".

The naming itself is illustrative for the activities taking place there. Free play fostered creative play, and the plays cape afforded lose parts and natural objects and materials to play with. Ply activities were observed related to the affordances of the vegetation and topography.

5 DISCUSSION

At the pre-test the reference group scored better than the experimental group. At the post test the experimental group had caught up with the reference group and significant differences between the pre and post test in all the items except for flexibility (sit and reach) were found within the experimental group.

Comparing the groups at the post test, significant differences in favor of the experimental group were found in the Flamingo balance test ($p<.001$) and the Indian skip co-ordination test ($p<.01$) - table 1.

Table 1

TESTS	EXPERIMENTAL GROUP		REFERENCE GROUP	
	Pre-test	**Post-test**	**Pre-test**	**Post-test**
Flamingo / 30”	**4.7**	**1.5*** **	**4.0**	**3.3**
Plate tapping/50taps	**35.0**	**28.1*** **	**29.9**	**27.4**
Sit and reach/cm	**24.9**	**24.4**	**25.3**	**25.5**
Standing broad jump/cm	**102.8**	**113.1*** **	**103.1**	**111.3** **
Sit-ups/reps.30sec	**5.3**	**6.5** **	**5.9**	**7.0**
Bent arm hang/sec.	**2.6**	**7.0*** **	**2.6**	**5.4*** **
Beam walking/sec.	**11.4**	**7.5** **	**7.7**	**7.2**
Indian skip/reps.in 30sec	**21.8**	**43.6*** **	**27.8**	**37.2*** **
Shuttle run/sec.	**31.9**	**29.7** **	**30.7**	**30.3**

(p<.01) *(p<.001)

The EUROFIT Motor Fitness Test was applied and the results showed a significantly better performance in the natural play area group than the traditional group.

6 CONCLUSION

This study has indicated the relation between versatile play in the natural environment and the impact on motor fitness in children. Significant effects were found in balance and coordination abilities. These are competencies that are of great importance to the children’s general mastering of their own body in relation to the physical environment.

There is a strong relation between the structures of the landscape and the functions of play. The forest itself represents an environment for play and learning that stimulates motor development and fostering in children. In the same time we still know too little about the learning effects from the natural environment, and more effort should be dedicated to further studies in this field.

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BETWEEN THE UNIVERSALISM OF THE HUMAN RIGHTS AND THE RIGHT TO DIFFERENTIATION

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Abstract: *Juridical sociology researches noticed the wish to regain the lost identity that manifest itself also within the advanced industrialized societies of the civilized world, where, more and more difficult, the individuals belonging to the majority national culture try to identify themselves with their own culture, that tends to atomize.*

Keywords: *society, human rights, culture.*

After the tragic experience of the XX^th Century (the first and second World War) the view in analyzing the fundamental rights and liberties centers on two main coordinates: a) *unity* of the human species; b) *universality* of the human values[1].

a) The coordinate of the *unity* of human species take into consideration the human being, the person, beyond any diversity of race, human groups, and other person interests considering the *human race* represents a *universal*, beyond any individual or group particularities related to race (Caucasian, mongoloid, Afro-American, Amerindian, or others, regardless the classification and qualification criteria, regardless the relativity of the racial classification)[2], or related to socio-professional characters, or sexual, linguistic, age, or value and religious beliefs of the human groups and population, or the economical situation, fortune, or of the social juridical statute of the person.

All these structures and substructures of antroposomatic and antropocultural constitute, together, the *human race* that's representing is *The Human Being*. The unity of the human species builds up on the dynamic binominal human *unity-diversity*.

b) The second coordinate, *universality* of the human values, is building up beyond the relativity of the particular values inherently in the diversity of cultures and civilization, every culture and civilization with its own specificity in becoming a historical-cultural nation, participating, with all the historical and spiritual experience, to the human values perenniality and universality.

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[1] Sélim Abou, *Cultures et droits de l'homme (Leçons prononcées au Collège de France, mai 1990)*, Paris, Hachette, 1992, p. 9.

[2] N.P. Dubinin, *Les races et la génétique contemporaine*, în vol. UNESCO, *Le racisme devant la science*, Paris, 1973, p. 150.

[3] Im. Kant, *Answer to the question: what is the „illumination"?*, in vol. Im. Kant, *An idea of a universal history. What is the „illumination"?, The beginning of the human history. Toward the eternal peace.* (trad. and stud. introd.: Traian Brăileanu), Bucharest, Ed. Casa Şcoalelor, 1943, p. 85.

So, in conceiving the human fundamental rights and liberties issue, we must start with a double dialectics: a) human *unity-diversity*; b) *universality* in comparison with the *particularity* and *relativity* of the values from a culture/civilization or others.

The entire juridical thinking on the human fundamental rights and liberties phenomenon should return, in a way, to the ideological-cultural accomplishing of the European Century of Lights (the XVIIIth), the result of the French Revolution (1789) – *Declaration of the rights of man and citizen*. Juridical and political culture of this Century underlined that the principle and the goal of any political organization is the man, in general, within the universality of the concept of man, the *abstract* individual, seen under its double aspect, both as *reason* and *freedom*, so that the man, in order to be free should give his reason a public use (as Immanuel Kant[3] stated in the XVIIIth century).

Although the French Declaration of Human Rights (since 1789) proclaimed the *principle of universality* of the rights and fundamental liberties of human being (in opposition with the *principle of particularity* promoted by the American Declaration in 1776, in the same matter)[4], the French principle have had a significant regress in comparison with the domination of the *nationalism principle* of the XIXth century (that have taken over the ideas of the Historical School of Law (Humbold, Herder), with its central thesis on the preeminent existence of a Volksgeist (the spirit of people) and also the antinomy *Geselschaft - Gemeinschaft (society – community*) brought in the German sociology by Ferdinand Tönnies[5]). The point of origin of this nationalism was the actual "axiological theme of thinking" of the XIXth century, absolutes the particularity, the national specific, denying, in consequence, any discussion, on a general level, regarding some universal instruments of the fundamental rights and liberties of the human being. All horrors of the First World War and Second World War were necessary to regain the idea of *man humanity*, through which it will realize a balance of antinomy contrariety between *universalism* (= the recognition of the equality as a relation between all people, all individuals, and, in consequence, a equivalence of all cultures by recognizing some interactions between economical structures and cultural systems[6], the importance of cultural diversities that rejects uniformity tendencies of the life style, behavior, and also, by recognizing the diversities of the normative systems by coexisting with different values[7] hierarchy) and *relativism* (because the equivalence of the cultures is just a simple postulate, in contradiction with the reality of facts[8]), which generates a right to differentiation, in order to see the morals, customs and cultural needs of each human community/society or of a group of states[9].

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[4] Blandine Barret-Kriegel, *Les droits de l'homme et le droit naturel*, Paris, P.U.F., 1989, p. 80.
[5] Michel Lallement, *The History of Sociological Ideas* (vol. I – *From the origins unttill Weber*), Bucharest, Edit. ANTET, 1997, p. 230.
[6] Amadou-Mathar M'Bow, *The Sources of the Future (Themondial problematic and UNESCO objectives)*, Bucharest Edit. Politică, 1985, p. 134.
[7] *Ibidem*, p. 118 şi 127
[8] Sélim Abou, *op. cit.*, p. 11.
[9] *Ibidem*; P. Modinos, *Conclusions et perspectives d'avenir*, în vol. W. J. Gandshof van der Meersch (coord.), *Les droits de l'homme en droit interne et en droit international (Actes du 2-ème colloque international sur la Convention Européenne des Droits de l'Homme – Vienne, 18-20 octobre 1965),* Bruxelles, Presses Universitaires de Bruxelles, 1968, p. 850.

Or, such a *right to difference*, referred to and reclaimed today by the societies which do not share the juridical ideology of European culture, of European inspiration, societies whom juridical culture differentiates clearly by the rationality of the law system, the way it was induced, in time, by the Romans, observing the Greek stoic conception (the old stoicism) regarding the *human solidarity*[10], tends to take a critical distance from the Universal Declaration of Human Rights (1848). The doctrine of the *right to difference* affirms that the Universal Declaration of Human Rights (1948) is a document that constitutes an explicit expression of the Cartesian, European rationalism, of occidental cultural tradition[11], with a universalism preoccupation, even if the O.N.U. Commission for Human Rights (instituted in the base of the art. 55 from the O.N.U Chart by the Economic and Social Council, main authority of the O.N.U., in conformity with art. 68 from the Chart), with the special contribution of the eminent Professor René Cassin, have had in view, in drafting this Declaration, different types of humanism, in conformity with the configuration of the representation of the member states in the Commission (in particular, occidental type of traditional humanism, central and west European Anglo-Saxon, French and Hispanic civilizations; Marxism humanism; Chinese humanism, especially the pragmatic and social side of Zen Buddhism[12]), while a large group of member states appertain to the Muslim law system (the Islamic type of juridical civilization). The foundation of this law system is the Koran (Qorân), Holly Book of the Islam, containing the Revelations of Allah, entrusted to his last prophet, Mahomet (b. 570- d.632), primary and absolute source of the Muslim law[13], in spite of a visible effort in updating this system to the exigencies of the contemporaneous life. So, there is, with all particularities of this law system, a polemical difference between the European type of juridical ideology and Muslim type of juridical ideology, induced, created and emphasized by the fundamentalism of the Islamic religion.

Which is generally claiming is the fact that the Universal Declaration of Human Rights (from 1948) doesn't make a place for the *right to difference*, in the way that the Declaration, in its substance, does not aloud references to the particular and cultural rights of the ethnic entities[14]. From the historical point of view of this Declaration, it must be understood that this Declaration was drafted, prepared, conceived and proclaimed shortly after the Second World War, the intention of the Commission was to declare principles that bring people together, not the ones that separates them again. After 1950 we assist to a massive return to *ethnicity*, to a nationalism-reclaiming, tendency that manifests at multiple levels, in different contexts and social, economical, political and cultural conditions. So, by introducing in the debates the syntagma-concept of the *right to*

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[10] Louis Lachance, *Le droit et les droits de l'homme*, Paris, P.U.F., 1959, p. 35 – 59.
[11] Philippe de la Chapelle, *La Déclaration Universelle des Droits de l'Homme et le Catholicisme*, Paris,, L.G.D.J., 1967, p. 12.
[12] *Ibidem*, p. 29 – 33.
[13] The juridical contain of the Koran reveals in *verses*, which rules the civil law and the personal juridical statute of the believers of the Islam, criminal law, judiciaries procedures, verses called "constitutional", international law. The Koran completes with Sunna, which reveals the way of being and the conduct of the Prophet, serving as guide to Muslim people, and which are, on the whole, *hadîth*, in which base could be drafted juridical rules (René David, Camille Jauffret-Spinori, *Les grands systhèmes de droit contemporain* (ed. 2-a), Paris, Dalloz, 2002, p. 349 – 365).
[14] Sélim Abou, *op. cit.*, p. 13.

difference, regarding the issue of fundamental rights and liberties, there is a wish to admit that there is a right of each people to affirmation, to defend or recover its cultural specificities. The *right to difference* signifies a (re)foundation regarding the matter of fundamental rights and liberties, on the binomial *identity-difference*, with a certain contrariety relation between the two terms. From the perspective of an aristotelic type of logic, eventually, the term "identity" plays the function of a *genus proximum*, while the term "difference" would signify *diferentia specifica*. The doctrine that admits the *right to difference* affirms that the issue of *identity* rises only when the difference manifest itself, because any human group affirm itself through the *difference*[15], juridical equality between persons and people contains the right to difference.

From the perspective of the theoretical efforts in imposing a *right to difference*, the genealogy of such a right has its starting point in reclaiming the ethnic-cultural differentiation of ethnic groups, which members are bound with each other through a common history or origin that is symbolized by a determining cultural patrimony. Such cases are, for example:

a) Ethnic native or immigration minorities from a given state;
b) Juridical constituted nations, which, beyond the ethnic groups that composes them, are defining as super nations under the empire of an assimilation politics, practiced by these nations and by the nationalist ideology of the group that holds the power. This power is centered on the exclusive type of exaltation of history and common patrimony of all people, no matter how heterogeneous is that nation (the case of de-colonized states);
c) The ensemble of nations/people that share a number of common cultural features (the language and the culture), supra-valorized, sacral, mystified by an unionist ideology of the correspondent states (the states that constitutes the "*Arab nation*");
d) The case of heterogeneous groups, less politicized, the ones identified as "colored people" or "India people".

In consequence, it can be affirmed a certain typology of the situations resulted from cultural and ideological finding and affirming the *right to difference,* in understanding and settling the "tensions" between the universalistic character of the Declaration and the ideological-cultural characteristics of the particular cultures.

The doctrine refers to four categories: 1. Uncertain identity; 2. Defending a threaten identity; 3. Liberation of an oppressed identity; 4. Regaining the lost identity[16].

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[15] *Ibidem*, p. 14.
[16] *Ibidem*, p. 15.

That is the situation if afro-Asian states. It has been ascertained, in this case, a reviving of the ethnicity, by a global discussion on "*occidental acculturation*"[17], that modified, substantially, the frame references of the national identity. Within the process of regaining the ethnicity, for an affirmation of the *right to difference* there are two points of view:

1) Most of the states tend to salvage all the acculturation phenomenon accomplished, which gave them and permitted the access to modernity. The kinds of states that prefer a complex synthesis of original identity are Senegal, Tunisia, India and Ivory Coast.
2) There are societies, states, ethnic groups that consider the cultural acculturation a process of alienation (in a wide perspective; in a restrictive way – juridical acculturation), process that had to be resisted, in order to recover the juridical cultural authenticity (a position adopted mostly by the Muslim countries).

The ideology of the authenticity tends to become a dominant ideology for the third world, involving the whole population in an anti-acculturation process. This signifies the brutal refusal of the occidental culture, inheritance of the colonialism, even if a big part of the material and technical elements produced in occident are considered to be indispensable for their modern life (specially, the technology of information).

This ideology of the authenticity has two specific coordinates:

a) *Politic mesmerism*, other said, mobilizing the live forces of the nation/people around a charismatic hero, which assumes the role of regenerator and savior of the nation/people.
b) *Returning to sources*, which assumes, as a task for the people, to rediscover the *original identity*, raised up as a *myth* (the case of some personalities like: N'Krumah, Mobutu, Kadhafi, Khomeiny), announcing the fundamental movements of the third world[18].

The need for defense of a lost identity characterizes the immigrated ethnic groups and the receiving nation or the native ethnic minorities within a state[19]. In these two situations, affirming the identity takes the role of a resistance against a threatening of assimilation. The immigrants usually integrate in the receiving society and adopt its culture, but perceiving this as a superior culture like their origin culture. But, at the same

[17] The concept of acculturation expresses the unequal changing process of the elements and forms of culture, as a result of the contact between two different societes/civilisations, under the cultural relation between them, a longer or shorter time contact, under the juridical aspect there is a fully transformation of the law sistem and the traditional juridical institutions of a population, in this case as an effect of colonizing the states in Africa ans Asia. (Vz. art. *aculturație*, în Romulus Vulcănescu, *Dicționary of ethnology (I. - Terminology; II. - Personalities)*, Bucharest, Edit. Albatros, 1979, p. 13 – 14; also, René David, Camille Jouffret-Spinosi, *op.cit.*, p. 56 – 59 ; regarding the expansion of the anglo-saxon european law system, for the afro-asian region: Jacques Vanderlinden, *Introduction au droit de l'Éthiopie moderne*, Paris, L.G.D.J., 1971; Amsatou Sow Sidibé, *Le pluralisme juridique en Afrique (L'exemple du droit successoral sénégalais)*, Paris, L.G.D.J., 1991; Emil Moroianu, Adrian Cornescu, *General theory of law*, Târgu-Jiu, U.C.B., 2005, p. 52 – 53).

[18] Sélim Abou, *op. cit.*, p. 17; Mendudi, *Introduction to Islam*, Bucharest, Edit. S.C. Charter S.R.L., 1991, p. 16 şi 18; Ali Mérad, *Contemporary Islam*, Bucharest, Edit. Corint, 2003, p. 90 – 91.

[19] Sélim Abou, *op. cit.*, p. 17

time, the immigrants do not want to be absorbed and de-culturalized by the receiving society. Usually, the immigrants groups live with a strong need of a reinterpretation and multiform combinations of a synthesis identity, of their own ethnic-cultural legacy and the culture of the adoption country. As an observation, a *massive* and *accelerated* immigration could mean, within the receiving society, a real social and cultural disturbance, endangering the integrity of the national identity of the receiving state (the case of France, Great Britain).

Regarding the native ethnic minorities, they are granted with equal rights acknowledged to the majority of people, but in fact, these ethnic minorities are under the threat of absorption (a large majority of those), into the majority of dominant population (the case of francophone minority from Canada, Christian minority from Lebanon[20]).

The case of experiences and formulated reclaiming of a oppressed identity characterizes the ethnic minority groups, deprived of the right to express the specific differences in major fields of social life, like Turkey and Iraq (at least until the falling of Saddam Hussein regime) where the Kurd population, paradoxically, considered itself oppressed, by the democratic regime from Ankara on one hand, and on the other hand by the absolutist regime imposed by Saddam Hussein, tried, and still trying a liberation movement in order to form an independent Kurd state.

Juridical sociology researches noticed the wish to regain the lost identity that manifest itself also within the advanced industrialized societies of the civilized world, where, more and more difficult, the individuals belonging to the majority national culture try to identify themselves with their own culture, that tends to atomize[21].

The entire issue of the juridical des-acculturation process and rediscovering the national/ethnic identity in the base of the *right to difference* generated the appearance of some theories and relativist ideology, which go on till the *idealization* of the primitive or traditional cultures (afro-Asian civilizations). Evidently, there are two types of these theories and relativist ideology:

a) Doctrines that consider the relativity of the cultures as something natural, in the way that recognizing the relativity of the cultures doesn't exclude the existence of some universal values, neither the possibility of an intercultural communication, and neither the advantages of a benefic acculturation in the process of modernization a traditionalist society;
b) Doctrines that affirm the culture relativity as being absolute, denying the existence of the universal values, stating the impossibility of communication between different cultures (as defining particularities and as a historical stage of evolution of those cultures), given the impermeability of those.

From these perspectives the absolutist position wishes to be also a critique and a rejection of the ethnocentrism culture and juridical civilization of a European type or

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[20] *Ibidem*.

[21] Oskar Handlin , *El pluralismo cultural en la sociedad moderna. Pertenencia etnica y unidad national: un dilemma norteamericano*, în vol. UNESCO, *Culturas*, vol. IV, nr. 2, Paris, 1978, p. 169; *idem*, *The Uprooted: The Epic Story of the Great Migration that Made American People*, Boston - Toronto Little, Brown and Cy, 1973, p. 286; Alexandre Bennigsen, Chantal Lemercier-Quelquejay, *Les musulmans oubliés. L'Islam en Union Soviétique*, Paris, P.C.M., François Maspéro, 1981, p. 78 -79 şi 275 ; Sélim Abou, *L'identitéculturelle. Relations interethniques et problèmes d'acculturation*, Paris, Éditions Anthropos, 1987, p. 213 - 219.

European inspiration. In reality, the rejection of the European ethnocentrism promotes other ethnocentrisms[22].

The French anthropologist Claude Lévy-Strauss made a sharp criticism of a European ethnocentrism, after which the social evolution theory (Herbert, Spencer and Taylor) appeared, on one hand, before the biologic evolutionism theory drafted by Charles Darwin (Species Origin, 1859), and on the other hand, promoted the theory of Lewis Morgan, which considered that the European society of occidental type places itself, on a evolution line, above all societies, by exceeding all historical stages of civilization, which other societies, *archaic* or *traditional*, still have to cross[23].

Thus, Claude Lévy-Strauss criticized the theory of social evolutionism, in accordance with, in what interests us, the European model is to be imposed as an absolute juridical model. The notion of *superiority*, regarding the relations between cultures, is a relative notion, having a diachronic and a synchronic character, the field and the contents of the *superiority* notion vary depending on the criteria that we accept a comparison of different cultures and civilizations, at least under a juridical aspect[24]. In Claude Lévy-Strauss thinking, the concept of civilization signifies a coexistence of cultures, each of them giving the maximum of diversity so that the concept of global civilization signifies only the fact that, on a global stage, we are dealing with a cultures/civilizations coalition, each of them preserving its originality[25].

So, all cultures are equal between them, each one has an essential function the protection of human/individual against the hostilities of the natural environment and the "turbulences" of history. Such a *functional equality* of the cultures/civilizations signifies an *equivalence* of them; this is how the particularly system of values legitimizes itself, no matter how different they are between them, due to the different cultures have the same function. As such, due to such equivalence of values, there isn't an absolute standard through which a fair evaluation could be achieved, and there can't be an absolute judgment of value regarding a certain culture or another[26].

The consequences of such pertinent theoretical position, absolutized by Strauss's juridical anthropology, consist in denying the opportunity of intercultural communication, other said, the only justified attitude from the point of view of an ethical scientific research is that of respecting, absolutely, the integrity, the *right to difference* of every juridical culture/civilization as a way to protect cultures of any noxious process of acculturation[27]. The doctrine of the *right to difference*, by absolutization the relativity of cultures, leads, finally, to the thesis of bad character of the intercultural communication, because the acculturation has as a consequence achieving a homogeneity of values of the different cultures/civilizations, which could mean, after the semiologist Tvetan Todorov, a "decision" on the death of humanity[28].

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[22] Sélim Abou, *op. cit.*, p. 24.
[23] Claude Lévy-Strauss, *Race et histoire*, Paris, Éditions Gonthier, U.N.E.S.C.O., 1961, p. 23-24.
[24] *Ibidem*, p. 46 – 50.
[25] *Ibidem*, p. 77.
[26] *Ibidem*.
[27] *Ibidem*.
[28] Ţvetan Todorov, *Nous set les autres. La réflexion française sur la diversité humaine*, Paris, Seuil, 1989, p. 91.

A part of juridical anthropology doctrine is denying an existence with necessity of the *universalism* by holding within itself the *universal-relative* dynamic (the way such a dynamic is clearing up within the cultural interrelations), dogmatize the notion of *cultural relativism* and absolutize the notion of *cultural identity*, the concept and the doctrine of the *right to difference* – operational in some limits – mystified, with pervert effects against even those who gave birth to them. As the Lebanon professor Sélim Abou remarked, “a right to difference (….) signifies the right to *closure*, the right to re-pression and, at limits, a right to *death*[29]”. Or, the theoretical direction of absolutization the *right to difference*, reasonable in some limits, is criticized within the contemporary juridical anthropology, because it’s forbidding the right of each human being to use its *reason* and *liberty*, to take a distance, through this critique reason, from its society and culture, necessary condition for transforming and criticize it. The man, as a person, doesn’t define himself only by the political society that he belong to and which is identified to, but mostly, by the permanent critique that he makes to the society where he is living in[30]. the French philosopher and anthropologist Pascal Bruckner, taking into consideration the negative consequences of absolutization the *right to difference* pointed out the danger that, based on the absolute respect for cultural diversity, there can be justified the most persuasive terms to explain and justify, culturally, the cases of cannibalism in a tribe or another, lapidating the adulterine woman or cutting the hands of thieves in some Islamic countries, sexual mutilation of the minors in some African societies and/or Asian ones, segregation and massacre of the ones considered to be *pariah* in India, according to the saying *each after his truth*[31]. More, the recognition of the *right to difference*, taking into consideration absolutization the relativity of the cultures, can be used as an intellectual alibi for any apartheid politics[32], the *right to difference* is to be synonymous with the *right to indifference*, because the adulate ethnical by the cultural relativism doctrine, could, facile, metamorphose in racism, placing the human rights under an absolute doubt, rejection the universality of the human rights an the oneness of human race[33].

Later, even Claude Lévy-Strauss – although he tries, from the point of view of the juridical anthropology, to propose a new theoretic fundament for the discussion on the human rights by an “economy of the concept of man” trying to substitute the definition of man being a *moral being*, an understanding of man as being a *living being* – concludes that, the final goal of the anthropology and ethnology is to surprise “certain universal

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[29] Sélim Abou, *op. cit.*, p. 32.

[30] Jannière Abel, *Anthropologie sociale et politique*, in vol. *Travaux et conférences du Centre Sèves 16*, Paris, Mediasèvres, 1989, p. 9

[31] Pascal Bruckner, *Le sanglot de l’homme blanc. Tiers-Monde, culpabilité, haine de soi*, Paris, Seuil, 1983, p. 194.

[32] Marc Augé, *Anthropologie et Droits de l’homme*, în vol. *Pour les droits de l’homme* (*Mélanges en l’honneur de l’ADLF*), Choisy/le/Roi, Librairie des libertés, 1983, p. 46 – 47.

[33] As so, from this point of view, in 1947, the Executive Bureau of the American Anthropological Association presented the Commission for the Human Rights of ONU a draft of a Human Rights Declaration, draft which fundament on the thesis that “goal that guides the life of a people are obvious by themselves regarding their importance for that people, and they cannot be, under no motive, exceeded by some pseudo-eternal truth”, that “ standards and values exist only in relation with their own culture, any attempt to postulate them beyond the beliefs and moral codes of that culture cannot be accepted”(*apud* Pascal Bruckner, *op. cit.*, p. 194).

forms of the thinking and morality"[34], the essential issue being the "universality of the human nature"[35]. The axial coordinate of the fundamental rights and liberties, on which is created the Universal Declaration of Human Rights (1948), namely the *universality* of the human values (and which consolidates the second coordinate of this construction – the *unity* of the human species) may resist and must be understood as being functional only by exceeding the relativity of the particular values inherent in the diverse cultures and civilization, each of the cultures and civilization specific of the people in their historical-cultural evolution, participate with all the historical and spiritual experience, to the perenniality and universality of the human values. It is still, the merit of the juridical and political culture from the European Century of Lights underlining the fact that the *principle* and the *goal* of any political organization is the man in general, within the universality concept of man, the abstract individual considered, under its double aspect, both as *reason* and *freedom*.

[34] Claude Lévy-Strauss, *Le regard éloigné*, Paris, Plon, 1983, p. 374 şi 377.
[35] *Idem, Anthropologie structurale deux,* Paris, Plon, 1973,, p. 35 – 36.

PLATO'S CONCEPT OF BEAUTY

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Abstract: *The aesthetic issues raised by the Athenian philosopher – the links between the concept of beauty and beauty as reality, between objective and subjective in the content of beauty and its nature, the beauty-good-justice relation, ethic and aesthetic or Eros and beautiful – remain present questions, engraving their echo in mankind's philosophical thinking throughout its history and also in the autochthonous aesthetic and creation.*

Keywords: *Plato, beauty, concept.*

1 PLATO AND THE SOCRATIC LEGACY

Plato's work constitutes itself as a true eulogy to his mentor, wrongfully sentenced, and to his memory which he wants to rehabilitate. Starting with the Socratic philosophy, Plato reaches the domain of ethical and aesthetic values, rejects the Sophists' ambiguity and asks for values' purification from relativity in order to give them the status of independent and self-sustained entities. Plato's theory of ideas changes from an ontology of values into a general one.

Plato goes far beyond his professor. If for Socrates ideas were just notions, concepts (results of intellectual activity), for Plato, the idea equals existence in its entire splendor (the world of things has its origin in this matrix). We have the idea of beauty as notion because its object, the beauty itself, it's an absolute essence. Only these ideas have an authentic existence and can be known or discovered by our minds, everything else beyond this produces just simple perceptions.

The Greek thinker uses the dialogue technique in his creation. His concept of beauty and its correlation with the other cognitive categories, moral, juridical or political, are exposed in the now famous dialogues where he transforms Socrates in his spokesman. The impossible distinction between the two persons raises the obvious question: from all Plato's work, which is Socrates' and which is Plato's? C. Noica, Greek's philosophy known expositor, formulates a possible answer: „if we'd known better the historical Socrates, and more, if we were told his work through somebody else than Plato, maybe then we could be able to make a distinction between the mentor and his apprentice." [1]

Beyond the natural limits, Plato's philosophy had a major impact on different levels of mankind's spiritual life, influencing philosophical, moral, political and aesthetic aspects. Directly or not, the greatest thinkers had adhered to or critically rejected the ideas of this Athenian philosopher. Looking through the most spread works of this field – from I. Kant to N. Hartman, B. Croce, G. Lukacs or U. Eco - we can recognize the presence of Plato's concepts. The aesthetic issues raised by the Athenian philosopher – the links between the concept of beauty and beauty as reality, between objective and subjective in the content of beauty and its nature, the beauty-good-justice relation, ethic and aesthetic, Eros and beautiful – remain present questions, having their echo in the autochthonous aesthetic and creation: H. Grandea ("The Definition Of Beauty"), Pop Florantin ("Aesthetics, The Philosophical Science Of Beautiness And Arts"), C. Dumitrescu Iaşi ("The Concept Of Beauty"), T. Vianu ("Aesthetics"), L. Rusu ("The Logic Of Beautiness"), P. Comarnescu ("Kalokagathon").

2 BEAUTY – CONCEPT AND AESTHETIC VALUE

„Beauty" represents in the same time a concept and an aesthetic value. Being identified with the aesthetic, it has been considered the most general and wide aesthetic category. Liviu Rusu, after analyzing mankind's fundamental values, points out the truth to be the sum of theoretical values; good – the symbol of moral values and beauty belonging to the aesthetic ones. [2]

The concepts about beauty belonging to the Latin-Greek and Judeo-Christian cultures have used – according to Wladyslaw Tatarkiewicz (in "The History Of The Six Notions") - not one, but three distinct notions: a. beauty having the wide ethical and aesthetic meaning (Kalokagathon); b. beauty having the exclusive aesthetic meaning (it triggers aesthetic reactions to color, sound and thinking; meaning that started to define the basic notion of European culture) and c. beauty in the aesthetic sense (limited to visual perceptions: form and color).

While the Oriental thinking regarded beauty as a mixture of perfection, harmony and mystery, Greeks regarded it as symmetry, rhythm, harmony and equilibrium. Plato and Aristotle established a philosophy of beauty and aesthetics as a philosophical subject.

For Plato, the way it's shown in his dialogues – *Hippias Major, Fedru, Philebos, Timeus, Symposium, The Banquet and The Republic* – beauty is the Idea of beauty that resides within things; it's not only about the exterior, but also concerning the inner side. The aspiration towards perfection has different steps: physical beauty, moral beauty and beauty itself - a walkthrough from reality to concept. According to Plato, „we have to understand that beauty existing in one body is related to another one from a different body. And if we would follow only the exterior beauty, it would be definitely wrong not to consider that beauty from all bodies is the same. And the one that understands this will eventually love all the beautiful bodies. (...) after this, will start to treasure the beauty that lives inside our souls. (...) and will discover the beauty that resides in people's customs and laws. (...) from habits and customs, beauty rises to sciences (...) and there is only one science that deals with the beauty we are talking about." [3]

Beauty is in the same time a supreme value and an ideal; life makes sense and worth living it when the man „learns to contemplate beauty itself". [4] Through the imaginary dialogue between the two actors – Socrates and Hippias – from Hippias Major, the Greek philosopher tries to define and explain the essence of beauty. After a difficult and arduous argumentation, the author concludes: beauty does not identify itself with any concrete form of expression – beauty as adequation, beauty as efficacy, utility, stillness, pleasure (regarding senses – hearing and sight), as enjoyable utility - , beauty is hardly if not impossible to define, „so hard are the beautiful ones". [5] Plato rejects the equivalence between beauty and good – „The good cannot be beautiness nor the beautiness be good, each of them being something different" -, even if good can be a generating cause for beautiness. Taking the effect for the cause, this type of confusion can be avoided by accepting the existence of beauty by itself, timeless and far away from any relativity, „a beauty that is forever, that has no birth or death, that gets no bigger or smaller; that is not on one hand beauty and ugly on the other; sometimes it is and sometimes it is not; beautiful for somebody and not so beautiful to the others (...) a beauty in itself that generates everything that is beautiful in this world, without any changes to its status, remaining always the same." [6]

Plato's concept of beauty assimilates perfection and good by itself which goes beyond the moral aspects and becomes the supreme principle of Ideas. In this world, everything is governed according to this centric rule. „The idea of good is the supreme knowledge – the idea through which the right ones and all the other goods become useful (...) towards which everything should go and aim".

The author assimilates good with the highest value because it contains beauty and truth in itself. It is made of a logical element (the truth), a mathematical one (symmetry) and an aesthetic one (beauty). In his work, The Republic, the moral good expresses itself through the moral beauty and the absolute beauty can be found only in absolute good people. For Plato, „To know the beautiness, the good and the justice, means to become good, beautiful and right. This is the way to get as close as possible to the divine". When the Idea, as a transcendental reality, comes down in the sensitive world, it introduces order and harmony; the beauty becomes measure, proportion and harmony. [7]

W. Tatarkiewwicz (in "The History of Aesthetics") remarks that through its sphere of content, Plato's category of beauty is very wide; it exceeds the aesthetic dimension by including the moral and cognitive sides. With this comprehensive concept, Plato – if we take a look at the considerations written in *Faidros, Filebos, Hippias Major or The Banquet* – remains underlined in the history of aesthetics as the author of the famous triad „truth-good-beauty", triad that symbolizes the highest human values in which beauty takes its rightly place. This concept was taken further in certain directions by the different thinkers that followed. [8]

Even more, Plato's concept of beauty does not limit itself to bodies, as the concept expands itself over souls and ideas, which posses a superior kind of beauty. Although not supreme, the spiritual beauty represents a step forward. Physical beauty is not forever, only the idea of beauty is. In this concept, the Greek philosopher pleads for the transcendental beauty by introducing an authentic revelation in the aesthetic thinking of that time: a) Plato has expanded the meaning of this concept over abstract elements, not accessible to experience; b) he comes with a new value system, the real beauty being regarded as second in place, in favor of the ideal beauty; c) he introduces a new criteria, a new unit for evaluating the beauty of real things: their distance or nearness to the idea of beauty. Plato stands out from his predecessor's thinking – gravitating around the pleasure of aesthetic experience (Sophists), around objective harmony (Pythagorists) or judging the relation between object's harmony and his utility (Socrates) – by using a new anchor point: the perfect idea of beauty that we carry within and helps us measure the beauty of things. [9]

3 OBJECTIVE AND SUBJECTIVE, ABSOLUTE AND RELATIVE IN THE CONTENT OF BEAUTY

In *Symposium or The Banquet*, Plato depicts and defines this side of the issue; objective and not subjective, absolute and not relative, the transcendental existence of beauty. He targets the perception of divine beauty, „the unique one". Only by trying to become one with divinity, the creator of the true perfection, only this can confer value to human existence. Beauty has a subjective and objective determination and it must be seen as a relation. The genesis of beauty is determined not by entities, things, deeds or events that mark our existence but by our way of correlating ourselves to them. „What we do right now, drinking, singing, debating – none of these things is beautiful in itself. Only through the way we do them can we make them beautiful, by doing them nice and right. If not, they become ugly, like love. Not every Eros is good and worthy of praise; but only the one that makes us love in the right way." [10]

One thing is not beautiful because we love it, on the contrary, we love it because it is beautiful and right (good). If this world is beautiful and if the creator is good, then it's obvious he had looked towards eternity, because beauty is forever.

According to W. Tatarkiewicz, Plato rejects the Sophists' definition that only tried to approach beauty from the subjective side. „I'm not interested, claimed the author, in something that appears beautiful to the people, but in something that it is beautiful". In order to support this affirmation, he calls the following arguments: a) beauty does not belong only to the objects that can be seen; b) beauty is an objective feature that belongs by default to beautiful objects and does not refer to people's subjective reaction in front of beautiful things; c) experimenting beauty is possible by an innate sense of beautiness and not by a temporary state of pleasure; d) not all that we like is necessarily beautiful. [11]

In *Filebos*, the author makes a clear distinction between the beauty of things belonging to reality (and their representations in picture) and the beauty of abstract forms, of straight lines or circles, of plain figures and geometrical shapes. The first type of beauty was regarded as being relative while the second one was assimilated with the absolute beauty, lasting forever for itself. The beauty of simple abstract forms and pure colors is a giver of special pleasures.

4 BEAUTY SEEN AS ORDER AND MEASURE

According to the Pythagorean conception adopted and taken further by Plato, the essence of beauty resides in order, measure, proportion and harmony. Measure and proportion go hand in hand with beauty and virtue, while disharmony is „always ugly". The interdependence between measure and proportion is obsessively underlined in some dialogues like *Filebos, The Sophist, Timaios or The Political Man*. Plato's definitions are worthy of remembering: „the essence of beauty, as the essence of any good, resides in measure and proportion"; „everything that is good is also beautiful, and beauty cannot lack measure"; „measure is necessary for the beauty of things because it confers them unity"; „in certain scenarios, measure should be understood as number while in others, as moderation and convenience". The quest for measure, similar to the one for order, proportion and harmony is typical for human beings and signifies „the connections with gods." [12]

Plato claimed that beauty does not depend on any measure, but on the adequate one, the one he also tried to discover. The squares from Menon (in which one side of a square equals half of the second's diagonal) and the triangles from Timoios (the equilateral triangle and the Pythagorean one) are perfect geometrical shapes which became ideals for artists and architects from antic and medieval times, when the triangle principle used to govern. Contaminated by the measure rule, order and harmony, Plato classifies arts in two categories: a) the good art (based on measure); b) the ugly art (based on people's emotional and sensual reactions).

5 CONCLUSIONS

Plato's remarks about beauty and arts are memorable and have profound implications in modern and contemporaneous aesthetic tendencies. Well-known expositor of mankind's aesthetic history, W. Tatarkiewicz makes an inventory of Greek's philosopher contribution to the development of aesthetic thinking: a) the consideration of beauty as a property of reality and not a human invention; b) beauty implies truth, good, measure, order and proportion; c) defining beauty requires a raportation to the moral good; in the ethic-aesthetic link, the supremacy of ethic is „so overwhelming that in his field, the aesthetic gets an auxiliary feature, fading to the state of a decorative metaphor" [13]; d) beauty-sublime-ugly are correlative categories (later on, Karl Rosenkranz will write an aesthetic of ugliness); e) art can only be based on knowledge; f) in this field there is no room for freedom, individuality, originality or creativity; g) in comparison with reality's perfection, the possibilities of arts are negligible.

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ROMANIA'S ROLE IN THE QUEST FOR POWER FROM THE BLACK SEA REGION

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Abstract: *The outcome of the power quest from the Black Sea region – in the new geopolitical and geostrategical context: the NATO and EU expansion towards east, the raised interest for Caspian energetic resources, the appearance of new and asymmetrical risks and threats – will influence the peaceful and stable climate both European and global. Starting from the indivisible security premise, Romania as NATO and EU member, must become a "dynamic vector" of stability and wealth in the Pontic area.*

Keywords: *Black Sea, NATO, security, stability.*

1 THE BLACK SEA REGION GEOPOLITICAL AND GEOSTRATEGICAL ROLE DEVELOPMENT

According to Romania's *Military Strategy*, our country is situated in a space of sensitive interest for the military strategy that is monitoring influences from the four areas: a) Central-European (future place for regional prosperity); b) South-Eastern Europe (instability generator); c) C.I.S (which confronts a legitimacy crisis); d) the Black Sea area (of strategically importance for the South border of NATO but also a transit route for Central Asian energetic resources).

Starting from a political-military obvious reality – „the rising of Black Sea's importance in Europe's energetic and security concerns" – *„The Romanian Security Strategy* (2006)*"* establishes a new target for medium to long-term plans: „building a prospere and secure climate along the Black Sea region", process in which Romania as NATO and EU member has to become a „dynamic vector" of stability and wealth in the Pontic area.

The Black Sea region has significantly increased its role, transforming Romania into an important character that must be listened. This new status can be evaluated by the following criteria: a) the geopolitical argument (The Black Sea is located at the interference of three zones of special geopolitical importance: Europe, The Middle East and Central Asia, space of numerous conflicts, exporting risks and threats to Europe; the Black Sea region is laid at the confluence of the two most important religions and peoples – Christianity and Islamism, the Slavs and the Muslims; the significant regional powers: Russia, Ukraine and Turkey – have their conceptions, strategic, political and economic doctrines based on the important role and the wide space of the Black Sea);

b) the geostrategical argument; Romania is situated at the confluence of seas' axis (The Caspian Sea, The Black Sea and The Mediterranean Sea) not to mention rivers or canals (Rhine – Main – Danube) which link the Northern Sea to the Black one, the latter being a strategic connector, linking the Euro-Atlantic community (as security provider and energy consumer) to the Middle East area - the Caspian region and Central Asia (as energy supplier and security consumer); it represents the interference space of three geopolitical and geostrategical zones which are considered to be the most fragile environments regarding security and stability (Southern and Eastern Europe and The Middle East); it represents the gateway to the Planetary Ocean for Ukraine, Romania, Bulgaria and the Transcaucasian countries; according to Brzezinski, resources and map position make Romania a strategic pivot, „a destination for all strategical interests" both European and American, permitting the development of military cooperation (Blackseafor); c) the geoeconomical argument; Romania is also located at geoeconomical axis' crossroad of West-East (Western Europe-The Eastern Former Soviet Area) and North-West – South-East (Germany and Central Europe – Minor Asia and Near East); the Black Sea region is a very attractive market made of over 320 million inhabitants; it becomes the first transit route for Russian and Caspian energetic resources and it is the main transport area and source for the consumer called Europe; the resources of the Caspian basin are estimated at 200 billion barrels and the ones of the Caspian seaside at 25 billion metric tons (representing 15% of global oil and 50% of world's natural gas); it has important submarine resources, a wide web of seaports and sea facilities, showing off an attractive and marketed seaside, offering a wide range of touristic and commercial cooperation; d) *the challenges'* argument: it's the default crisis area; „the threat of a major military confrontation in Europe has significantly faded"; nevertheless, the region has to deal with asymmetrical and transnational risks: the international terrorism, the WMD development, the local conflicts (after the former USSR disintegration; the East: The Moldavian Republic, the Nistrean region; the East and North of Georgia, Abkhazia and South Osetia; Western Azerbaijan, Nagorno-Karabakh; the South of Russian Federation – Chechnya and other republics or autonomous regions from the Northern Caucasus), drugs and human beings traffic, illegal immigration and inefficient administrations. [1]

In the now-existent balance of forces and security climate established within international relations, the Black Sea has acquired new and significant geopolitical, geostrategical and geoeconomic valences, becoming e true challenge for the West which aims for the integration of regional specific issues into a global conception having well underlined goals: the propagation of democratic ideals and values, the establishment of a secure area in order to fight and eradicate the terrorism phenomenon while consolidating world-wide stability and peace.

The Black Sea region is in everybody's sight, whether certain countries are directly involved or not (China, EU, NATO and US), because of its huge importance in oil's and gas' transportation towards Europe and also because of its nearness to Middle East and Caucasus area. [2] The NATO Istanbul Summit (2004) recognizes in the final document, 41st paragraph, Black Sea's importance regarding Euro-Atlantic security. The Alliance shows its availability to sustain and cooperate with the river-side states, gesture followed closely by the EU which in 2006 integrates this zone into European maritime space and by US which declares Black Sea's space as being of strategic interest.

2 CHANGES AND TENDENCIES IN THE REGIONAL SECURITY ENVIRONMENT

Becoming areas of asymmetrical and unconventional risks, South-Eastern Europe and the Black Sea region require a new thinking in the individual and collective security strategy domains.

The security environment from the Black Sea region reveals new aspects: a) neighboring countries' affinity for NATO and EU integration; b) their increasing dependence of Russian energetic resources; c) Russia's efforts to recreate its traditional alliances and influence zone; Moldavia and Ukraine being positive in their relations with the Kremlin (Moldavia – neutrality and warranties for Russian properties from Transnistria; Ukraine – slowing down its NATO integration, privileged status as a Russian-speaking country, certain advantages for Russian investors; Moscow backs-up this orientation with the following arguments: Moldavia – guaranteed status for Transnistria along with the territory and boundaries of Moldavia, natural gas' price, rising the embargo for wine-industry; Ukraine – reasonable price for natural gas); d) internal crisis are intensifying in certain countries belonging to the region (Ukraine – the political fight for dominating internal and external policy between president and prime minister; Georgia – the energetic problem, the Russian troops' presence, the separation tendencies of Osetia and Abkhazia and Georgia's steps towards West); e) the delicate approach seen in Turkish diplomacy regarding the Black Sea security, the general security domain separation from the maritime security which is treated as a distinct level of regional security; certain countries' trend to become regional leaders (Greek and Turkey); f) the tendency to isolate Russia (NATO's expansion towards East; the establishment of military bases in Romania, Bulgaria and other CIS members – Ukraine, Georgia; the antiballistic shield from Czech Republic and Poland, which according to Russian magazine *"Nezavisimaia Gazeta"* will lead to a double surrounding of Russia through the two circles drawn by the military powers of NATO and US; a Russian military official said that after the process will be over, Russia's geopolitical situation will get even worse; one of the goals is limiting the action area of Russian navy from the Black Sea, Baltic Sea and Pacific Ocean, another one could be that of cutting off the distance to the main military and economical Russian targets, the geostrategical interest zone – Asia or The Middle East – while enforcing the striking capabilities of NATO and US forces) [3], throwing it out of the Caspian energetic resources transport and distribution (through building new gas and oil pipe lines avoiding the country).

Troubled by West's aggressive strategy, Putin warned in February 2007: "We have to think and to think, undoubtedly, to assure our external security and all our retaliations will be asymmetrical but of a high efficacy level. We already have antiballistic defense systems: the new *Topol-M*, as you probably know", this way he transmitted the American defense secretary, Robert Gates, Russia's concern regarding US intention to establish military bases on Romanian and Bulgarian ground. "For the first time in history", Putin warned, "devices belonging to the American nuclear system are located in European territory. For us, the shield looks like a display of forces from Pershing to our boundaries, it is an identical threat. These systems will control Russian space spreading towards Ural Mountains if steps to strike-back will not be taken, but we will." [4] At the Oslo Summit of the 26 NATO member states, dating April this year, inside the NATO-Russia Council, we have seen Lavrov - Russia's minister of foreign affairs, saying that the whole European security architecture is in danger due to the ongoing events. Russia's decision was to suspend the Treaty regarding Conventional Forces in Europe - the symbol of Cold War's ending. I. Baluevskii (in "Krasnaia Zvezda"), chief of Russian Army's Major State, trying to complete his president declaration, asks the country to reconsider its strategy and move from a symmetrical to an asymmetrical military construction.

Nowadays, „Romania's security as European state can be seen and defined only within NATO and EU, depending on the policy of the two organizations". Through this perspective, the way it is shown by „The White Book Of National Defense and Security", our security is „defined at the crossroads of supranationalism, multinationalism and regionalism" and aims for the following goals: „fighting against organized crime, illegal human beings, drugs, forbidden substances and weapons traffic", trying to secure national boundaries which „in the near future become the boundaries of democratic and united Europe". [5]

S. Celac, attempting to redraw the area's geopolitical importance rising in the new international political context, pleads for the active involvement of West into the Black Sea region for the following reasons: a) the involvement of the wide Black Sea region in the democratic stabilization process, sustaining economy in the Middle East; b) creating a new additional programme for NATO and EU cooperation in an area where their interests coincide; c) the enforcement of NATO capabilities to engage operations outside the area – The Middle East – and sustaining partners outside the alliance; d) positively approaching Russia by taking into account its legitime security interests which are easier to implement in a stabile and prospere environment; e) developing a region identity for the Black Sea as a valuable West partner through wise politics and coordinated actions of EU, NATO and US. [6]

Becoming NATO and EU member (in 2007) made Romania a powerful military factor on the South-Eastern border of NATO, status validated by our involvement in operations from Golf, Bosnia, Serbia, Afghanistan and Iraq.

3 NAVAL FORCES' IMPORTANCE IN THE POWER GAMES AT THE BLACK SEA

Naval Forces, a division of Romanian Army, represents for sure a crucial component of our country's maritime power. According to the *Military Strategy*, „it is and will remain a fundamental institution which assures security".

If by its first directive, the army has to „be prepared to prevent, to discourage and only if necessary to defeat a possible aggressor which threatens the security of Romanian state, in the same time with the participation at different operations in order to avoid conflicts, to end crisises or help collective defense in the neighboring area", Naval Forces have the responsibility of „protecting the country from any kind of threats from sea or rivers, taking care of naval Romanian interests in the same time with the participation in operations regarding regional peace and stability, independent participation or in cooperation with the Allied Forces." [7]

No matter the level of combat actions, strategic, operational or tactical, Naval Forces with their specific units – surface ships (frigates, corvettes, missile carrier ships, motor torpedo-boats, mine-dredgers, mine-layers, artillery ships, river motor-boats, special ships and logistical ones), submarines, military divers, coast missiles, naval infantry and navy air force –, classes and types of ships in service, take part in specific operations.

A comparative analysis of riverside states from the Black Sea – Russia, Ukraine, Bulgaria, Turkey, Georgia and Romania – gives us the necessary information to evaluate the role that each state could have in the context of these power games having place in the new geopolitical and geostrategical context.

Romanian Naval Forces, at the beginning of 2007 were making use of the following capabilities: 1 submarine („Killo" class); 3 frigates (2 type 22 and 1 type M);

groups of navy helicopters (3); 3 NPR („Tarant II” class); 3 motor torpedo-boats („Epitrop” class); 4 corvettes („Total” class); 4 maritime dredgers („Fly” type); 1 Mine layer (Cosar); 3 monitors (M. Kogalniceanu); 5 bullet-proof motor boats (Rahova); 12 river motor boats; 1 marine infantry battalion; 1 diving ships division (combat and deep dive); 1 demagnetizing ship („Magnetica – 298”); 4 rescue tugs („Viteazul", "Grozavul", "Hercules" and river tug 302); 2 oil tanks (TM 531, 532); 2 maritime command ships („Egreta” and „Luceafarul”); 3 river command ships ("Siretul", "Mureşul", "Fortuna"); 1 river rescue and transport motor boat; 4 intervention ships ("Midia", "Venus", "Jupiter", "Gr. Antipa"); 2 logistic support ships ("Constanța", "Midia"); 1 hydrographic ship ("Emil Racoviță"); school-ship „Mircea”, transport-school ship „Albatros”; and ships like 419 and BF 455. [8]

Russian fleet from the Black Sea, after the disintegration of USSR, had between 3000 and 635 ships along with a 70 000 personnel; following 1995, it possessed 14 submarines, 31 coast and surface ships, 125 fighter planes, 85 helicopters and 40 000 people.

In 2002, the Russian Naval Forces from the Black Sea, were made of: 2 divisions of surveillance submarines (14 subs „Foxtrot” and „Killo” class; only 10 of them being operational); 1 helicopter carrier cruiser; 2 missile carrier cruisers; 2 missile carrier destroyers; 3 missile carrier frigates (having SS N-2, 22 and 6 C type missiles); 11 torpedo-boats; 1 mine-hunter; 10 mine-dredgers; 5 roads dredgers; 10 troop transport vessels; 2 troop transport hovercrafts; 12 patrol boats; 6 electronic scouting ships; 7 supporting ships; 7 bomber aircrafts; 22 multi-role jet planes; 10 hydroplanes; 4 scouting planes and 70 combat helicopters.

Russian Fleet can perform the following tasks: destroying enemy’s seaside assets; engaging and destroying naval squadrons from ports; blocking enemy’s attempt to penetrate their communications; surveillance over maritime communications from the Black Sea via geostationary satellites; troops transportation and unloading in crisis areas like Kosovo, Transnistria, Chechnya and so on. [9]

Turkish Military Navy consists of: 17 submarines ("Preveze", "Ay", "Hizierreis" and "Muratreis" class); 19 frigates ("Barbaros", "Knox", "Gabya" and "Yavuz" class); 1 destroyer; 21 missile carrier motor-boats; 1 mine-layer; 5 mine-hunters; 16 mine-dredgers; 7 ships for tanks transportation; 2 school ships; 38 automatic-unloading vedettes; 22 patrol vedettes; 2 logistic ships; 5 fuel tanks; 6 water tanks; 2 transport ships for liquid or solid merchandise; 1 submarine rescue vessel; 1 rescue-assisting vessel; 5 maritime transport tugs; 2 divers rescuing boats; 2 special ships; 2 hydrographic and oceanographic research ships; 1 scientifically research ship; 8 school-motorboats; 30 fighter planes and 20 Asm helicopters; 3 attack helicopters and 7 school-planes.

This represents the most important force; it can execute specific peace, crisis and war missions: surveillance, research, information gathering operations as well as it can maintain peace, do search and rescue missions and furthermore cooperate with the Allied forces against international terrorism and organized crime, destroying enemy’s seaside assets, executing antisubmarine or mine hunting operations, maritime interdiction and maritime traffic naval control. [10]

Ukraine’s Military Navy Forces feature: 1 submarine; 1 command ship; 1 cruiser; 2 frigates ("Krivak" class); 2 light frigates ("Petya" class); 6 corvettes; 4 missile carrier ships; 3 patrol vessels; 1 mine dredger; 2 mine layers; 3 troop transport vessels; 5 hovercrafts; 42 coast and river patrol ships; 1 auxiliary ship; 1 oil tank; 2 rescue boats; 2 research ships; 1 surveillance and acoustical research ship; 1 ships for munitions transport; 1 base ship.

Navy Infantry has 265 shielded transporters and 60 mobile artillery systems. Navy Air Force features a 7 000 personnel; computers and endowments; 2 bombing squadrons made of 45 Tu-26 planes, 39 Tu-22M, 18 Tu-16, 10 Tu-22 and 50 Tu-16 aircrafts, the last ones in conservation; air to ground aviation: 45 Su-17 and 44 Su-25 jets and also 41 Su-17 and 129 Su-25 in conservation; hunting jetfighters: 63 MIG-29 aircrafts; antisubmarine planes: 23 Be-12 type; 31 Mi-14, 49 Ka-25 and K-27 helicopters; 21 electronic warfare planes; 2 AN-12 aircrafts; 12 Tu-16 type and 6 Tu-22 planes; 1 of 11-20 type; 5 Ka-25 helicopters; helicopter dredgers type Mi-14; 3 in the air refueling planes.

Ukraine's military fleet at the Black Sea is capable of the following types of missions: discouraging aggression; neutralizing enemy's naval forces; destroying enemy's means of transport; protecting Ukraine's own bases and communication lines; protecting its own submarine space and water territory; guarding over the commercial fleet and state's oil industry; the defense of economical maritime area; the terrorism combat; the participation in international peace-maintaining actions. [11]

Bulgarian Military Navy Forces consist of: 1 submarine, 1 frigate; 6 corvettes; 1 missile carrier ship; 5 missile carrier vedettes; 10 patrol vedettes; 6 mine layers; 12 mine dredgers; 2 troop transport vessels; 3 oil tanks; 1 ship for divers; 1 demagnetizing ship; 1 rescue tug; 1 transport tug; 2 transport helicopters; 8 search and rescue helicopters.

Georgia's Naval Force is small: 1 patrol ship; 3 patrol frigates; 2 missile carrier motorboats. [12]

If we should make a naval power ranking of the riverside states from the Black Sea, taking into account their troops, ships' features, aviation and technical capabilities, it would probably look like this: Turkey, Russia, Ukraine, Romania, Bulgaria and Georgia. The first two can independently perform every type of operations, while the others only partial and preferably in cooperation. [13]

We must not forget that Russia and Ukraine are countries that posses weapons of mass destruction as well as nuclear ones. The possible usage of this kind of trump card can anytime change the ranking above.

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METHODOLOGICAL ASPECTS OF LEARNING THROUGH COOPERATION WITHIN SEMINAR ACTIVITIES

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***Abstract**: Pedagogical innovations in the second half of the 20th century have greatly lead to the decrease of the proportion that frontal education used to hold in the time economy of educational activities. The curriculum innovations, like the one known as „mastery learning", as well as the ones that emphasized the individualization and differentiation of the curriculum, have made room for small group education and learning through individual activities. Thus the organization and deployment of university educational activity, together with frontal classes, most of the times held as lectures, seminar activities grow ever important thanks to their contribution to achieving educational goals.*

***Keywords:** education, seminar, university, method.*

Many of the seminar activities in the academic environment are developed in small groups, with the intention of achieving the following goals: student cooperation abilities development, increase of inter-student communication, improvement of personal responsibility in fulfilling assumed tasks, whetting of thought efficiency, adjustment to team research assignments, surpassing psychosocial barriers etc.

The methodology of seminar activities deployment varies, teachers managing to increase efficiency and the degree of attractiveness due to the complement of action-based modern methods to traditional ones, making seminars interactive. The active methodology that is to be used within the seminars sets off the conditions that may favor the efficiency of these methods. We shall depict some methodical bearings that influence the students' active involvement in academic activities:

a. The students' refusal to undertake the role of active participant to the seminar leads to a slow intellectual start of and diminishes from the very beginning the means of reflection and expression. Therefore, encouraging and helping the study group are a sine-quanon condition to succeed in having all students actively and efficiently involved;

b. Being nervous in the beginnings of getting involved is a natural condition. Its negative effects consist of not being able to react in a manner that is appropriate to the situation.

Surpassing this can be achieved by a strong interest for the educational activity in discussion. This is there the need to have the entire educational process organized based on the students' needs end interests;

c. Each active involvement of the student in the academic process bears the blueprint of each individual. The attempt to stop this need to individualize leads to the annihilation of active involvement. This is where the need to encourage the personal approach of educational activities instead of the stereo typified one derives from;

d. Using traditional, scholastic methods of strictly conducting the students' activities, generates on a regular basis the students' refusal to be actively involved. They consider that the activity lacks in value because the way it is handled does not meet their expectations concerning their being treated as adults;

e. The lack of active involvement in seminar activities may be explained by the fact that students consider the information to be irrelevant, uninteresting for their future profession;

f. Teaching students within their future profession environment increases the active involvement, explanations endorsing the certitude that the activity is a serious, interesting and practical one.

g. Group activity involvement increases if the group is organized as a research, study or action group;

h. Abstract, undefined objectives of the activity may result in a lack of involvement. Precise objectives, on the other hand, that have as starting point a real situation, the students' aspirations will enhance their wish to get involved in the activity.

i. Methodical organization of the seminar is essential. No matter how noble the objectives or how spectacular the endowments are, only a strong academic strategy to have students involved could be efficient;

j. Active involvement depends on the communicational level with the teacher, that's why having a high level of empathy is important;

k. The level of the students' active involvement will not supersede that of the teacher, which is why the teachers has to commit totally, responsibly, creatively, and efficiently when it comes to organizing and deploying the educational activity.

We shall present some methods that are active by definition, and that can be successfully used within seminar activities irrespective of the subject. The seminars that are not focused on rendering information, but on developing attitudes, values, behaviors, habits the *role play* method can be used; within course-independent seminars, that hold new contents and must be assimilated and deepened, the *mosaic* method can be used; the course-complementary seminars, that suppose resuming already taught information and adding-up new one, the method *I know / I want to know / I have learnt* can be used.

Role play is an active teaching-learning method, based on relation simulation activities, positions, social status, phenomena, all these followed by the analysis of representations, behaviors, attitudes, observed during the simulation. Students have the opportunity of becoming actors of the social and professional life, which they are preparing for, having their abilities, competencies, behaviors, convictions shaped.

There are some *methodical steps* to be taken while preparing and using role play:

- identifying the relationship that needs simulation through role play and that is according to the desired goals;
- having the situation modeled and the instruction scenario anticipated;
- group organization, actor selection, training of actors in the specific and demands of role play;
- allowing actors to get their roles ready and revise their instructions;
- playing the role play game;
- reflection and group discussion on interpretations, content analysis and identified behaviors analysis.
- The methodical requirements of a role play game can be:

- when setting up status, the teacher must consider each participant's wishes, dreams and inclinations;
- before starting playing the game having some introductory exercises organized;
- help create a relaxed, pleasant ambiance, in order to simulate actors and prevent blocks;
- each actor must know the requirements concerning his / her behavior as well as his partners';
- each game should be played several times, in order to ensure the consolidation of all behaviors;
- the teacher must watch carefully, in each actor, the way they assume and interpret their role, the degree to each they identify with the part they're playing and help the others fulfill their tasks;
- the students that will not be actively involved in the activity must be assigned either organization issues or observer tasks, with tangible, and their activity is valued in the end.

Role play categorization involves two large categories, each of them with other subcategories:

1. Generic games:

- *structure representation games* – help students understand how organizational structures work within a system (for History, Management, Economics);
- *decision–making games* – simulation of different situational contexts that forces the student to make an important decision (History, Management, Law, Economics, Military Science, Pedagogy);
- *arbitrage games*- developing the understanding, mediation and solving of conflicts that could affect two persons, groups, economical entities a.s.o. (for Economics, Law and Social Sciences);
- *competition games* – simulation of winning over a real or imaginary adversary, through different strategies, optimal solution identification, always respecting the rules of the game (for all subjects that may include competitive situations).

2. Specific games:

- *negotiation games* – simulation of sale-purchase situations, commercial, banking transactions, simulation of negotiation for conflict resolution (Economics, Management, Social Sciences);
- *teacher-students game* – simulations of educational situations;
- *platoon commandant-platoon game* – simulation of situations and activities specific to the military profession.

The pedagogical value of the game consist of the fact it turns students active from a cognitive, affective and motric point of view, places them in a situation where they have to a interact, to expert self control on their own behaviors, it highlights good and bad behaviors and actions in various situations, it supports complex understanding of situations, it represent an efficient method to help convictions, attitudes, habits and good, desirable, correct behaviors be formed.

The mosaic method is a method promoted by those in favor of teaching – learning in the critical thinking manner and may be used on a variety of topics, during seminars that approach the study of materials that have not been studied during a course, but that can be found in printing (books, courses, etc.). The teacher established the study theme, which he then splits into sub themes. The group of students splits into sub groups of 3 to 5 students, depending to the number of fragments that the text was split into, each number of the group getting a fragment. The initial sub groups temporarily separate in order to form expert groups of those who share fragments with similar contents. The expert group prepares the subject, debates it, and finds the best way to present it to the others colleagues in the original group. Then groups get back together and they present each their fragment to the others that are experts on the other topics. In the end students are evaluated on the entire material. The mosaic method involves all students who have precise tasks and that study the content they have to present to the others, try to anticipate their questions, search for examples and effective explanations, and try to render an interesting presentation. It is common knowledge that one does is more thoroughly understood than what one hears or sees, and this method fully proves that this statement is true.

The I know / I want to Know/I have learnt method is a method that tries to make students aware of their own knowledge activity, critical thinking is not a subject, it's the level that our mind reaches at the moment where we think critically out of habit, as a natural way of interacting with the ideas abd information we get or discover. At the same time it stands as a process that takes place when the one that is learning asks questions like "How is this information significant for me?", "How can I use this information ?", "How can I link this information to previously acquired one?", "What could be the consequences of putting this information into practice for me and the others?", "What's my opinion on this?", "What can I do differently now that I have this information ?", "How are beliefs affected by these ideas ?".

Together with the group, at the beginning of the seminar, the already acquired knowledge is stated, no matter the source of that information. Each student puts down in the first column of the table the most important ideas that he knows on the subject. Then they are asked to put down their questions, curiosities, concerns on the topic in the second column of the table. From now on the seminar will be conducted according to content, objectives, group characteristics, a.s.o. (collective discussion, group activities, learning through discovery, role play, a.s.o.). at the end of the seminar students will be asked to put down the main ideas of the things they have learnt during the class in the third column of the table.

I KNOW (what we think we know)	I WANT TO KNOW (what we want to know)	I HAVE LEARNT (what we have learnt)

In a frontal discussion, the teacher can find out how the activity responded to the students' need and interests, can get suggestions concerning future contents, can make recommendations concerning the methods that students can use to find answers to the problems they are interested in thus, immediate feed-back can assure the premises of improved educational activities according to the academic needs of the students.

Present time educations promotes a competitive environment more than a co operational one, putting aside the positive inputs of cooperation: team spirit development, help spirit, high academic motivation stimulation, self trust development, better degree of knowledge of the another, differentiate learning, self expression for students, cooperation with the teacher that turns into a partner, an organizer, a facilitator, a person that supports the students.

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BALANCE OF POWER AND HEGEMONY.
THE TRANSDNIESTER CONFLICT

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Abstract: *Trans-Dniester Moldavian Republic is situated between the Republic of Moldova and the Republic of Ukraine. Territorially the state encompasses areas on the left bank of the Dniester River, the town of Bendery and some villages on the right bank. The capital of Trans-Dniester Moldavian Republic is Tiraspol (population 194,000 as of 1 September 1999). The dispute between Transdniester and the rest of Moldova remains unresolved. Decade-long talks supervised by the OSCE, Russia, and Ukraine have failed repeatedly, attracting criticism that Russia is unofficially supporting the separatists, although Moscow has not formally recognized Transdniester's existence.*

Keywords: *transdinester, conflict, forces, power.*

At regional level, the Transnistrian conflict is a geopolitical conflict through which Russia wants to maintain under its control the Republic of Moldova and not admit in this way the NATO expansion, the GUAM consolidation, etc. At local level, the stake of this conflict is the exercise of control on the Camenca, Dubasari, Grigoriopol, Rabnita and Slobozia departments and the city of Tiraspol, on the left shore of the Nistru river and on the Tighina city, on the right shore of the same river.at the end of the 1980's, the political scene of URSS was in full change due to the perestroika policy initiated by Mikhail Gorbaciov, which permitted the political liberalization at regional level.(1) Some national minorities opposed the changes of the communist political class from the Republic of Moldova, dominant class during the soviet period of Russian and Ukrainian ethnics. The institutionalization of the Romanian language and the introduction of compulsoriness of the Latin writing to write the latter have attracted protests from the speakers of other languages than Romanian. In Transnistria, region in which the Slav ethnics (Russian or Ukrainian) were the majority in the urban areas, protests broke out, and on 2 September 1990, the Nistrian Moldavian Republic was proclaimed. On 25 August 1991, the Supreme Soviet of this territorial entity passed the declaration of independence. On 27 August 1991, the Republic of Moldova's Parliament passed the Declaration of Independence of the Republic of Moldova, which territory included also the departments from the left of the Nistru. The Parliament of Moldova asked the URSS Government to begin negotiations with the Parliament of Moldova regarding the illegal occupation of the Republic of Moldova and the withdrawal of the Soviet troops from the territory of the new state. After Moldova received the UN membership status (2 March 1992), the President of Moldova, Mircea Snegur has ordered a military intervention against rebel forces, which had attacked police stations loyal to Chisinau from the Eastern shore of Nistru.

The rebels, helped by Soviet troops, have consolidated control over the largest part of the disputed area. Troops of the 14th Army (which belonged to the Russian Federation), stationed in Transnistria, fought for the secessionist Transnistrian forces. On the eve and during the armed conflict from Transnistria a series of military groups from the 14th Army have passed under Transnistria's jurisdiction with the effectives and the equipment supplied. So, the 66 engineer corps, dislocated in the village of Parcani, has passed over onto the secessionists' side with all the fighting equipment, being excluded from the states of the 14th Army by an order of the Russia's Defense Minister, which demonstrates clearly that Moscow knew and accepted the implication of its military forces in the Transnistrian conflict(2). The army of Moldova found itself in inferiority, thing that hindered the Republic of Moldova to regain control on Transnistria. On 21 July 1992 a cease-fire agreement was signed. After the cease-fire, Russia continued to offer the secessionist regime military, political and economic support, allowing it to survive and giving it a certain degree of autonomy towards Moldova. General Lebed, commander of the Russian Operational Group (ROG, former 14th Army), starting with June 1992, has acted as a Transnistrian politician and threatened Romania that his army might get to Bucharest in 2 hours. This Operational Group of Russian Troops from Transnistria – has at present around 1.500 soldiers in the region, about which the Russian Government says they are necessary to guard the arms and ammunition stored. Under international pressure, Russia at the OSCE Summit in 1999 at Istanbul, has signed an adapted version of the Treaty about Conventional Armed Forces in Europe, through which they engaged to retreat its troops and military equipment – estimated at 50.000 arms and more than 40.000 tones of ammunition – from Transnistria until 2002. But Kremlin did not respected its engagements, so that these force can be found dislocated on the Republic of Moldova's territory even today. Some villages from the Dubasari department which geographically are in Transnistria, but which during the conflict have risen against the secessionist regime, are now under the control of the Republic of Moldova's Authorities. These villages are: Cocieri, Molovata Noua, Cosnita, Pirita, Pohrebea, Dorotcaia, Roghi, Vasilievca. Corjova village (where the Vladimir Voronin, the President of the Republic of Moldova, was born), suburb of the Dubasari city, is divided into a part controlled by the Republic of Moldova's Authorities and a part controlled by the secessionist authorities. At the same time, some cities that geographically are in Basarabia have remained under the control of the secessionist authorities of Tiraspol. It is about the city of Tighina and the villages: Gisca, Protiagailovca, Chitcani, Merenesti, Zagornoe, and Cremenciug. A possible source of future conflicts is constituted by the situation of the Vasilievca village, which administratively belongs to the village of Cocieri, but which is after the strategic road that ties Tiraspol to Ribnita. Also, a part of the agricultural land belonging to the village of Dorotcaia, is after this road. The secessionist authorities tried repeatedly to forbid the locals access to the lands that belong to them and found after the road, reason for which a part of the agricultural land remained not tilled. The Basarabian village Varnita, suburb of Tighina, constitutes another center of latent conflict controlled by the authorities of Chisinau, but claimed by the Transnistrian secessionists. In July 2002, OSCE, together with Russian and Ukrainians mediators signed a document that contained pre-requisites for the unification of Moldova into a federation. The fundamental non-concordances on the reunification of Moldova made impossible applying this document. In November 2003, Russia drew up a memorandum that contained the proposal of constituting an asymmetrical federal state of Moldova. This contained also that Russian troops stationed on Moldovan land for 20 more years(3). Published initially in Russian, on the site of the Transnistrian Ministry of the Exterior, the text was promoted by Dmitri Kozak. Kozak is not a dilettante on the Russian political scene, he is a very tough politician, and very appreciated, and close to Putin, native of the same city as the Russian president. "The Kozak Plan" was a blitzkrieg type movement of the Russian diplomacy, which was supposed to be finalized in Maastricht, where Russia was supposed to appear as a peace-maker, with a document officially signed by Voronin and Smirnov in Putin's presence, who intended to have an express visit at Chisinau, with exactly a week before Maastricht. In the memorandum it was proposed, among others, the establishment of a bicameral parliament formed from an inferior chamber, elected by proportional representation. But all the laws had to be approved by the Senate, the division of which was disproportionate according to the division of the population on territories: 13 senators elected by the federal inferior chamber, 9 by Transnistria and 4 by Gagauzia. Against the Kozak memorandum large demonstrations took place the days following the publication of the Russian proposals. The leadership of the Republic of Moldova refused signing the memorandum without the coordination of European Organizations. President's Putin visit in Moldova was canceled. In a press conference in 2005, the President of Moldova Vladimir Voronin declared that the Kozak memorandum from 2003 was rejected because it was in contradiction to the Moldovan Constitution that stipulates Moldova's neutrality, and does not allow that foreign troops station on its territory, while his country cannot join military alliances.

Russia's interests. Transnistria's political and economic ties with Russian authorities are evident. In the same way evident as Moldova's interest in guarding its influence and its possibility of stopping a frozen conflict, from the center of a casemate planted EU's and NATO'S side. In Transnistria, one of Russia's objectives was, in fact, to maintain the Republic of Moldova under the political guardianship of the former decisional post-soviet center, using the Nistrean region as a primed fuse, which can be re-lighted anytime. The Transnistrians became a model for the gagauz in Comrat who launch simultaneously a secessionist movement, threatening Chisinau with the possibility of junction between the two rebel areas from East and south. Tiraspol "the capital" of the secessionist region will become the key of the region and the most dogmatic part of the Russian Bolshevik movement will be renewed here(4). Russia's economic strategy deserves to be carefully followed. Slowly but surely, the Russian State takes over important economic objectives after a ship-shape plan. Enterprises reach a bad economic sate, are privatized by off-shore firms belonging to "straw" persons, after which are sold to State companies in Russia, or, in a first phase, to some Russian or Ukrainian oligarchs with strong bonds to the political environment. In case of future lawsuits brought on by Moldova, Russia founds itself in the position of a good-faith buyer. And in the case of a withdrawal of the armed forces, the region is controlled economically. Russia's security doctrine shows that the Russian Federation examines with worry the concentration at the Southern side of C.S.I of states that are about to become NATO's military bases, and could have weapons of mass destruction. Moscow will never allow the disintegration of the Russian Federation and will continue the rebuilding process, in different ways, to the old URSS borders. Moldova, found in the Southern flank and considered as a buffer zone both by NATO and Russia, will find itself willingly or not compressed between two strong force fields, with few chances of finding a way out especially in the present political context, when Communist Government, obedient to Moscow, has moved away Moldova both from

Brussels and Bucharest. Indifferently of the NATO's expansion to the East, Moscow will not withdraw its troops stationed in the C.S.I. states, being interested to maintain the Federation's protection line on the range Kaliningrad – Tiraspol – Simferopol (Crimea). One of the measures Russia took is the use of the demographic weapon by consolidating the presence of the Russian element (favoring the dislocation of persons of Russian origin in areas of extreme interest to Russia, including Transnistria). The increase of the rhythm of implantation of Russian citizens, from which many are military personnel in reserve, proves that the authorities from Kremlin also aim to consolidate the presence in states bordering the Federation, with the purpose of ensuring a buffer zone at the possible fault breach between the NATO's Easter border and the Western borders of CSI (5).

Ukraine's interests. The main Ukrainian proposals in Transnistria's problem have been grouped in the Iuscenko plan. Through this plan Kiev proposed to Transnistria to elaborate its own Constitution, according to the Constitution of the Republic of Moldova, to have its own symbolism (flag, coat of arms, hymn), three official languages (Moldovan, Ukrainian and Russian) and to participate in the promotion of the Republic of Moldova's foreign policy in issues that present interest for Tiraspol. Also, the Ukrainian plan offered Transnistria the right to self-determination in case the Republic of Moldova decides to adhere to another state and/or in case of the Republic of Moldova loosing its right of international subject. The exit of Transnistria from the constitution of the Republic of Moldova will happen under international supervision, based on decisions taken within the frame of a referendum, to which will participate the majority of the population of the region(6).

USA's and EU's interests. At EU's level a reality is still weakly perceived: in Basarabia or Transnistria is not only played the faith of European outlying regions, but also – the same as in the Balkan's case here can be decided the faith of the entire South-Eastern side of Europe and NATO. The Russian military bases from Moldova's territory, from the secessionist area of Transnistria, in the cities of Tiraspol, Tighina, Bolograd, Artaz, as well as the underground storage of weapons will never be abandoned by Russia. The present situation in Transnistria can directly affect the citizens of the European Union. The fact that so close to the European Union a state exists where can hide and rebuild groups of organized crime is a reason more for worrying. USA and EU are the only factors that could intervene efficiently in solving the crisis in Transnistria. Until now they have done it more formally, proving rather lack of interest. The entreaties and invitations sent to Russia to respect its commitments and to leave the area are hilarious. Lately in USA the change of policy at the White House and the rise of interest towards the region was translated into an increased attention to the quality of information and evaluations and bringing to the fore ground of some more important experts to asses the region. The result was the change of USA's representatives – Ambassador Hyde Smith being withdrawn from Chisinau. The Occident opposed the signing of the Kozak memorandum and it is assumed that from now on USA and its West-European allies will not allow a settlement of the dispute that will lead to the "transnistriation" of Moldova. Chisinau seems to become today a stake somewhat more important in the West's operation of "surrounding Kremlin". The transnistrian issue starts to play a meaningful role in the shaping of the future geopolitical configuration of the continent, so that the Americans seem to have decided not to let at OSCE's will the solving of the problem. Transnistria remains an open wound for Europe and to close this wound is necessary a common effort from Romania, European Union and United States.

1 ASPECTS REGARDING THE LOCAL BALANCE OF POWER.

Transnistria's Army. Establishing a strategy of "protection of the independence gained in the fights from 1992", the authorities of Tiraspol have undertaken very serious actions in order to instruct and form a strong army, established on apparent and less apparent supports of the former 14^{th} army. The secessionist leaders have constituted with the Russian military support an impressive army, equipped with modern military technique, consisting of tanks, missile installations, engineering troops and even fight aviation, using the industrial potential of plants from the region to increase its arsenal. Russia's leadership sustained the survival of the regime from Tiraspol through considerable non-refundable aids, as well as through a skilful cobweb of conditions, declarations and memorandums, mediated by representatives of Kremlin. The territory of the Republic of Moldova is almost entirely controlled by Russia. Tiraspol's artillery can easily reach Chisinau. Transnistria hides other military capacities too: according to some Occidental sources, in Transnistria there is an underground network where is hidden part of the Russian military technique. In the ensemble of tunnels would be inclusive long-range missiles, withdrawn by the Russians from East Europe. The present "Military-industrial complex" from Transnistria, formed around the former 14^{th} Army, (Russian) contains: 1 division of motorized infantry, billeted at Tighina; 2 regiments artillery; 1 regiment tanks; 1 regiment anti-tank; 2 regiments engineers and pontoneers; 1 regiment missiles; 1 escadrille of military helicopters. The 14yh Army disposed of 5.000 active soldiers and 80.000 reserve soldiers, who can be immediately activated. In the area there are also: a plant for production of nuclear weapons; a centre for the control of the communications; paramilitary units (in the towns of Camenca, Rabnita, Slobozia, Dubasari). The Transnistrian army consists of 4 brigades of motorized infantry, a battalion of tanks, an artillery regiment and an anti-aircraft regiment. The regular army has around 4,500 soldiers plus around 15,000 in reserve. They have 18 T-64 tanks, 69 armored transporters, 60 artillery pieces and 50 mine launchers, 8 helicopters and 5 planes. The popular militia is well equipped and trained and is a regular force of about 2,000 persons from which 70% have battle experience. It is organized in 7 battalions(7). The Transnistrian paramilitary workers battalions are organized by OSTK, "The Unified Council of Work Collectives" and by "The Women Union for Defending Transnistria", lead by the famous Galina Andreeva, very active in the 1992 Moldavian-Transnistrian conflict. In 2007 the Russian forces named the Operational Group of Russian Forces in Moldova, under the leadership of the Moscow Military District have 1500 soldiers that include the motorized brigade and a regiment of ground-air missiles.

Moldova's Army does not posses the entire range of weapons. During the conflict in 1992 it proved incapable to lead a tactic attack of great intensity, despite the superiority of the artillery and the supremacy in air. The lack of some armed combined modern forces, assault artillery and tanks made impossible an offensive operation at the level of brigade or battalion. The insurgent Transnistrian forces benefited from a small armored force from the Russian 14^{th} Army and defeated the motorized Moldavian units. The Moldavian defensive could not face, either in open land or in fortified positions, the combined Transnistrian forces. According to the National Military Doctrine in the case of an aggression on the Republic of Moldova, the National Army has the duty to reject the enemy's air or terrestrial strikes and to bring maximal possible destructions onto the aggressor, not to allow the entry deep within its territory and to create conditions to stop battle actions at an initial level and reach peace with conditions that correspond to the interests of Moldova. The main type of battle actions of the National Army, regardless of the starting and unfolding form, is defense realized by regular troops and territorial defense units(8). According to data from 2005 the Republic of Moldova had 693.913 citizens with the ages between 15-49 years able for military service. *In 2005 43.729 turned 18 years old*. The military expenses were in 2006 of 150 million $, which represents around 0.4% of the GDP. The army of Moldova consisted in 2006 of 10.00 soldiers in the service of the Ministry of Defense, organized in three brigades of motorized infantry, an artillery brigade and an assault battalion. The equipment consisted of 56 ballistics missiles; 77 armored transporters, 67 armored vehicles; 18 canons of 122 mm and 53 of 152 mm; 9 howitzers of 120 mm; 70 Spigot AT-4 anti-tanks, 19 AT-5 Spandrel and 27 AT-6 Spiral; a SPG-9 launcher of 73 mm, 45 MT-12 of 100 mm anti-tank canons; 30 ZU-23 of 23 mm and 12 S-60 of 57 mm, 8 Mi-8 helicopters, 5 transport planes inclusive an Antonov An-72 and 25 SA-3/-5 anti air-craft missiles. The armed forces of the Republic of Moldova contain also frontier guards in the suborder of the Council of Ministers, with 8.000 soldiers and carabineers in the suborder of the Ministry of Interior with 2,000 persons. The duration of the military service is 1, 5 years. The main bases of the army are concentrated in the South around Cahul, in the North in the Balti department and in the centre of the country around the Capital. Russia and Moldova carried out peacekeeping exercises, starting with July 1999. This implicated 54 Moldavians and 80 Russians. At the second exercise carried out at the preparation centre of the army at Bulboaca, in 2000, took part 34 Russian soldiers from the Kantemir division – Moscow military district(9).

2 REGIONAL BALANCE OF POWER

In order to keep the analyse at subregional level we took in calculation the military forces of the 3 main actors of the area: Romania, Russia and Ukraine.

Table 1. Air Forces(10)

	Russia	**Ukraine**	**Romania**
Personal		55000	13250
Su-35	11		
Ka-50	16		
Ka-52	9		
Tu-160	16		
A-50 M	16		
An-72	20	26	
An-22	21		
Mi-26	25	25	
Ka-27/28	88		
Tu-95	92	withdrawn	
Tu-22M	162	withdrawn	
Mi-8/17	195	380	
Il-76/78	230	100	
Il-80	4		

	Russia	**Ukraine**	**Romania**
Su-25	275	60	
Mi-24	260	280	
Mig-31	325		
Mig-29	453	225	
Mig-25	5		
Su-24	458	200	
Su27	452	65	
An-124	25		
Mi-28	28		
Su-30	20		
Su-33	26		
Mi-14	9		
Ka-60	7		
Su-34	8		
Tu-134		2	
L-39	450		
Yak-28		35	
An-12		21	
Mi-6	5	50	
Yak-52	No data available	230	16
An-2		50	
Yak-40		6	
An-30		8	2
An-26		28	4
An-24		13	2
IAR-330 Socat			24
IAR-80 Puma			80
IAR-316			16
C-130 Hercules			5
IAR-99			22
IL-22		1	
Mi-2		111	
Be-12		14	
Mig-21			106
UAV	MBVK-137; Pustelka; 100 RPV-Pchela-It	No data available	65 (RQ-7 Shadow

Table 2. Ground Forces(11)

Categorie	Russia	Ukraine	Romania
Personnel	395000	88.500	45.800
Tanks	22.800	889	1200
Armored vehicle	15000/9900	2638	2100
Special Forces	Spetznay brigades; Ministry of Internal Affairs troops; Anti-terorist and FSB special Forces	MVD troops and KGB troops;	Ministry of Internal Affairs troops; Anti-terorist Brigade of SRI;
Mortars	6000	No data available	No data available
Selfpropelled Artillery	6000	641	175
MLR	About 4500	641	375
Towed Artilery	12765	1128	About 1000
Antiaircraft Artilery	About 2500 including 256 Tunguska M1	About 70 Tunguska M1	2×35 mm system Viforul; 2×30 mm Gepard

Table 3. Naval Forces(12)

Type/country	Russia	Ukraine	Romania
Personnel	About 25000	About 12000	6,800
cruisers	1 Slava class	1 Slava class	
Destroyers	3 (2Kara class, 1 Kashin class)		
frigates	1 Krivak II, 1 Krivak III	1 Krivak II, 1 Krivak III	1 Marasesti class; 2 modernized Type 22
corvettes	5 antisubmarin Grisha class; 2 Bora class; 2 Nanuchka III class	3 antisubmarin Grisha class; 1 Petya II	2 Admiral Sebastian Eustatiu, 2 Admiral Petre Bărbuneanu, 3 missile corvette
Torpido Boars		2 Pauk 1	3
Purtătoare de mine şi dragoare	4 Natya class+2 unknown class	1 Yevgenia class, 2 Sonya class, 2 Natya class	5
Rescue ships			3
Electronic Surveillance ships			1 Emil Racoviță class
submarines	1 Kilo class, 1 Tango class	1 Foxtrot class	1 Kilo class unoperational
Trening ships			1 Mircea
Missile Boat	6 Tarantul III class	No data available	2 Matka class

Type/country	Russia	Ukraine	Romania
River ships	No data available	No data available	14
Patrol Boats	2 Grisha III	1 Zhuk I	
Amphibious	3 aligator class; 3 Ropucha 1; 1 Ropucha 2	1 Aligator class; 1 Ropucha 1; 2 Donetsk Pomornik; 1 Konstantin Olshansky; 1 Polnocny	
Suport ships	2	2 Vytegrales 1 Lama Simferopol, 1 Moma, 1 Primore, 1 Kashtan, 1 Elbrus , 1 Agos	9
Comand ships		1 Slavutych	
Naval Aviation	18 Mig-29, 18 Su-24, 4 Su-24 MR, 6 Mi-14 , 4 An-12, 5 An-26, 4 Be-12	12/4 Ka-27/29, 18 Ka-25, 5 Mi-14, 1 An-12, 1 An-26, 8 An-24, 8 Mi-8, 1 Be-12, 1 Tu-134, 5 IL-18,	3 Puma Naval

3 CONCLUSIONS

Signals abound, indicating that "the solution" of the Transnistrian conflict is an intense debate subject. The six meetings Putin – Voronin, the Ukrainian President's visit in Basarabia, different releases from duty in Chisinau, the airline ticket for Valeriu Pasat, recent declarations of European high officials, the imminent solution of the Kosovo issue and many others suggest such a thing. Somewhere, behind the curtain, the regional geopolitical scene's important actors and less important ones debate the future status of Transnistria in the reintegrated state. At geopolitical level, we assist to a diplomatic recalibration of the region, where the foreign political vectors of some national or global actors will inevitably clash. But the novelty element is another, namely the fact that the national interests will be internationalized or Europeanized, and the global ones will get a national "coat". Distinctions become more and harder to make. The tendencies of the last years show that Russia is a recovering power but the balance of forces between Russia – NATO continues to be in the Alliance's favor. After NATO's first expansion wave, the forces' balance between NATO and Russia is 5:1. NATO has built his military potential, through the reduction of personnel number on the basis of some more efficient weapons systems. Romania based on the recent economic growth has increased its military expenses which will lead to the acceleration of the modernization of its military capacities. The one that seems to loose most, is at present Ukraine, which although has inherited an extraordinary military power from the former URSS due to economical weakness and political instability risks to remain with an obsolete military technique. We appreciate that in the future the USA's and EU's role in the settling of the Transnistrian conflict will grow. Russia will continue to play a first level role in the Transnistrian conflict as long as the American's attention will be oriented towards the Middle Orient and other conflict areas that might consume American military resources. Russia's role and importance in this conflict will be determined by the conservation of the present rhythm of development and growth of resources allocated to the army. We appreciate that, in the short run, major changes of the balance of power between the main actors both at a local level as well as at regional level, are not foreseen.

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MARINE PREVENTION POLLUTION AND SUSTAINABLE DEVELOPMENT - HIGH EDUCATION PROGRAM

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Abstract: *Naval industry operates mainly on international market servicing over 80% of the world trade. Until recently, naval transport was a comparatively static sector of world economy in terms of its technology, as well as its organization. However, with the fast advance of new production and management technologies,the environment in which naval industries (include water transport, port activities, shipbuliding and connex activities) exists and develops put forward new requirements for new qualities of this sector [1], [3].*

Taking into consideration these facts the discipline of – High Education Program for Marine Prevention Pollution and Sustainable Development - has to meet the folowing requirements:

- preparing specialists for the needs of naval industry with the necessary fundamental knowledge connected with sustainable development.

- practical skills with the immediate readiness for passing from the stage of classroom conditions of training to real-life situations in water transport, port activies and shipbuliding for environmental quality assurance.

- specialized preparation according to the requirements of international conventions in naval industry.

To achieve these goals, the master's in Marine Prevention Pollution and Sustainable Development it is based on complex training that includes:

a) fundamental training in mathematical and phisical principles environmental systems and computer sciences.

b) optimization and modelling on thermoenergetics process in naval and port systems.

c) prevention and reduction polution for particiular cases (oil, NLS, seewage and solid waste, ballast water, air pollution etc.).

d) shipdesign and marine prevention pollution principles.

e) implementation Environmental Management Systems in naval industry.

f) ecological impact and environmental audit.

The need for specialists in naval industry has become permanent and there are great oportunities for realization in this domain. The development of the world naval industry indicates that this tendency will continue for long in the feature.

Keywords*: marine prevention pollution, naval industry, high education program.*

1 INTRODUCTION

High education program for ”Marine Prevention Pollution and Sustainable Development” provides a qualitative education through a sustainable politics principles. At the whole teaching period of studies the accent is focusing on the practice, technologies (conventional and unconventional) and politics which take into consideration the interdependence between energy and environment under the technological and socio-economical aspects [2], [3] ,[4]. MSc programme is elaborated for three profiles Nautical Studies and Maritime Transports, Ship Systems and Propulsion, Management and Naval Engineering. The accepted group of students will have the possibility to participate at the general engineering courses who are promote clean technologies and environmentally friendly management practices according to the scheme below:

1. Environmental policies.
2. Sustainable development in naval industry.
3. Environment modeling. Clean technology in naval industry.
4. Sustainable power generation and utilization. Renewable energy sources in naval industry.
5. Marine Prevention Pollution.
6. Environment management in naval industry.
7. Environmental Impact Assessment in naval industry.
8. Emergency Plan Management.

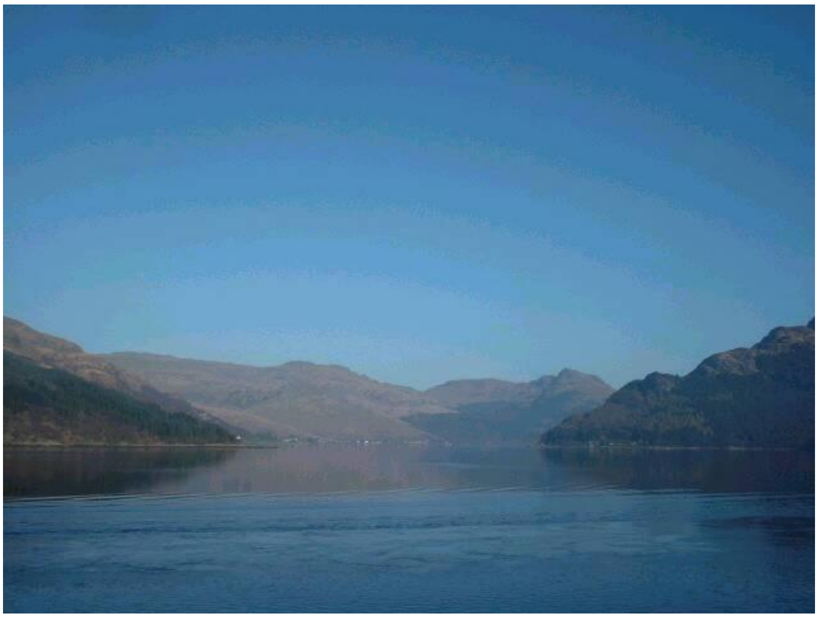

Fig.1 Marine environment prevention pollution - Sustainable Development in Naval Industry in the new millennium

2 DIRECTION ACTIVITY

Energy and Environment Policies and Economics

The major discipline aim is the knowledge spreading concerning European environment policies in naval industry nevertheless economical aspects of the problems in this area.

Sustainable Development in Naval Industry

"Sustainable Development in Naval Industry" course provides some world wide use major economical, social and legal elements, concerning the environment and development in naval industry. The sustainable development offers a framework through that the communities can use resources with efficiency, can create infrastructures, protect and improve life quality, create new commercial activities for water transport, port activities, shipbuliding and connex activities consolidation, fig.2. It can help to create a healthy community, which will be able to sustain the new generation and the following ones.

Fig.2

Environment Modeling

The course's is directed to the mathematics description, modeling and prediction of the environment, using modern software programs (SOPEP, GNOME, GLOBALLAST systems etc.).The Marine Environment, Natural and Human resources process are done with he global environment protection analyses.

Clean technologies in naval industries

The course's aim is to explain and to accustom to "environmentally friendly shipping" concept, which assumes a rational resources (raw material, energy and natural resources), expelling toxic raw materials utilization, reducing toxic offal volume effluents and gas evacuations – the strategy which directs to the interdependence between specific interactions in naval industry.

Sustainable Power Generation and Utilization

The course's aim is to generate more profound knowledge in the energy generation domain in water transport, port activities, shipbuliding and connex activities order aim is to analyze different power plant and installations from the technological, economical, ecological and competitiveness point of view.

At the end of the course the students will be able:

• to know different method principles of energy production from traditional and as well as renewable energy sources;

• to effectuate thermodynamic analysis of different traditional methods of energy production in naval industry;

• to estimate economic efficiency of different power plants and installations and select the optimal solutions for concrete conditions in water transport, port activities, shipbuliding and connex activities;

• to estimate environment state, proposing monitoring emission measurements.

At the same time, the course's aim is to spread knowledge in energy and resources efficient utilization domain. The students should learn theoretical and practical courses and to be able:

• to effectuate the energetic and exergetic balance of a naval industry technology and to determine the energy losses places;

• to effectuate the thermal calculation of: naval and port frigorific installation, heat pumps, other equipment;

• to effectuate the calculation and to analyze the functional regimes of distributed power networks.

Renewable energy sources

The course presents efficient methods of conversion and utilization of renewable energy sources in naval industry: solar, wind, hydraulic, biomass energy, nevertheless the advantages offered by hydrogen and cells combustion in electrical and thermo energy production.

Marine Prevention Pollution

1. Regulations for the Prevention of Pollution by Oil
2. Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
3. Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
4. Prevention of Pollution by Sewage from Ships
5. Prevention of Pollution by Garbage from Ships
6. Prevention of Air Pollution from Ships
7. Control and management of ships' ballast water to minimize the transfer of harmful aquatic organisms and pathogens.

Environment management in naval industry

The course's aim is to offer knowledge about European requirements in this domain (technical solutions and management mechanisms of navigable way monitoring, for example). This knowledge is necessary for quantitative and qualitative balance and survey activity of the environment, fig.3. The course presents the methods for application and utilization of the engineering science and informational and control technologies science in marine environment management.

At the same time, the course provides knowledge about the aim and objectives of the waste management, strategic planning elements in naval industry, waste classification, EU stipulations concerning waste management domain; waste recovering and elimination methods; incineration and other waste concept; design and construction of the naval and port ecological equipment; naval industry "actors" responsibility in the waste generation.

Fig.3 Environment degradation – management deficiency cause

Environmental Impact Assessment in Naval Industry

The identification methods of the naval industry atmospheric impact of the marine environment (air, water sources, soil and subsoil, biological ecosystems) and socio-economical and health will be studied. The course ends with the measurements analysis of the environment impact reduction.

Emergency Plan Management

The course's aim is to offer knowledge about international requirements in this domain: Global Integrated Shipping Information System (GISIS); prevention of pollution; Oil tankers – emergency regulation; Marine Environment Conventions requirement for emergency situation; IMO Member State Audit Scheme Responding to Oil Spills; Oil tanker safety and Carriage of chemicals; Pollution by Oil and Chemical Product intervention technologies; Ship recycling; Port reception facilities and Emergency Plan Management etc.

Fig.4 Emergency intervention

3 CONCLUSIONS

In the study it has been shown that a number of participants in sea transportation, port activities, shipbuliding and connex activities already should be act in favor of the environment. Charterers of crude oil, oil products and chemical oil tankers as well as of forest products carriers refuse to take ships which do not comply with defined rules of safety and environmental standard. Cargo owners sometimes demand that their cargo is transported by “green ships”. Such market-driven behavior seems to be very successful to promote environmentally friendly naval industry. Also a number of ship-owners already have acted to equip and operate their vessels with an environmental standard considerably above the international level.

Thus, the need for specialists in naval industry has become permanent and there are great oportunities for realization in this domain. The development of the world naval industry indicates that this tendency will continue for long in the feature.

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ECONOMIC, SOCIAL AND ECOLOGIC ASPECTS OF THE EUROPEAN POLICY REGARDING THE WATERBORNE TRANSPORT

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Abstract: *The shipping industry (including waterborne transport, port operation, shipbuilding and other related domains) is nowadays a very well represented sector within the worldwide economy. Within this context, the technical progress as well as the ever growing competition in this domain will lead to important changes in the next years, starting with the enhancement of cargos and services exchanges by means of the merchant vessels, as well as the promotion of sustainable development principles in activities related to shipping industry. This paper analyses the economic, social and ecologic aspects related to waterborne transport and port operations. From this point of view, the paper completes the already existing technical preoccupations at national level, with new research directions, which will permit a modern interdisciplinary approach of the sustainable development matter in the shipping industry included in the European maritime policy.*

Keywords: *waterborne transport, European policy, economic, social*

1 EUROPEAN POLICY IN THE WATERBORNE TRANSPORT

European history (with its economic and social aspects) is strongly related to the great voyages, which proved the vastness/immensity of our planet, the variety of cultures and the richness of its resources. Most of the voyages were at sea. For their success, openness to new ideas, details planning, courage and dignity were required. On the other hand, the European geography has been forever one of the main reasons of the special relationship Europe has had with the oceans. Ever since remote times until today, seas and oceans, rivers and waterways have played a deciding role in the development of European culture, identity and history. Often enough they have been the most important natural factor, which engendered the economic and social progress, well-being and higher standards of life. By its average and long term policies, the EU tries to revive its economy through waterborne transport as well. In this sense, there are complex courses of action for the development of the economic potential maritime dimension, waterborne transport (waterways included), port operations as sources of well-being for the European citizens. European statistics say that between 3 and 5% of the European gross national product is ensured by industries and services from the shipping and port operation domain (without including the value of raw materials such as oil, gas and fish) and the maritime regions represent more than 40% of the GNP, [1]. Over 90% of the EU foreign trade and 40% of the home trade utilizes the maritime and river transport [2].

The supremacy of Europe in this global industry is certain, summing up 40% of the world fleet from which 3.5 billion tons of cargo per year and 350 million passengers represent the turnout of the European ports and over 350,000 persons work in ports and related services producing together a value added of 20 billiards of Euro.

The prospects for these sectors are of continuous growth tightly related with the volume of the world trade, with the development of short sea shipping and the maritime waterways in Europe.

Within this context and particularly in the case of this country the maritime and river transport can represent an impetus for other economic sectors. Romania, as part of the European area, tries to win a position on the international maritime and river market starting from the assumption that the waterborne transport and port operations are essential for the international trade, at least in compliance with the relations according to the world economy. The development of shipbuilding and naval equipment as well as the specific services such as insurances, banking services, brokerage, classification societies, consultancy and marina represented by tourism are domains of interest which can contribute to the economic growth and implicitly to the improvement of life quality at national level.

2 ECONOMIC DIMENSION OF EUROPEAN POLICY REGARDING WATERBORNE TRANSPORT

Starting from these assumptions, the living standards of people are tightly related to the level of development of means of transport and implicitly of transport infrastructure. The economic approach of this matter reveals the ever growing necessity of human mobility determined by various phenomena such as geographic dispersion of economic activities and the tendency of abandoning the old urban areas, the extension of distances between the working places and the residential areas, the rapid development of the tertiary sector, which requires a certain professional mobility, the increase of the free time duration, which determines the development of voyages/journeys with tourist purposes and the recreational outings. Therefore, transports represent not only an activity devoted to transport services but also a means of efficiently enhance the efficiency of free time utilization. The development projects on average and long term on waterways transport will have to lead to a harmonious, coherent and balanced evolution specific for the European economies.

The European experience shows that the development of transport infrastructure represents a condition for the successful implementation of the other priorities of development of Romania for the period 2007-2013, contributing to the mobility of persons and cargoes and to the development of the regional and local infrastructure. Romania has the guiding lines for the development of the European and national interest ways/means of communication through the Arrangement Plan of National Territory section I “Communication Waterways”, as a support of complex and sustainable development of the territory on long term, including the regional development, representing the specific contribution of our country to the development of the European area and the starting point for the enrollment in the European socio-economic development dynamics.

The future economic growth, the society evolution and the territory developments will exercise an ever-growing pressure on transport, imposing a constant improvement of infrastructures and services quality. The demographic evolution, the development of the tourist sector, the reorganization of the production processes and agriculture, the dispersed occupation of the urban outskirts, stands for the increase of the demand. This demand is accompanied by a demand of services quality which should be met/satisfied in the context of Romania's access to the to the European post-adherence funds, which will contribute to the increase in the infrastructure investigation. The demand for transport (for all variants: land, rail, air or sea) analyzed as a consequence of the increase in the volume of cargoes corresponding to the international trade is tightly related to the economic development.

A viable alternative of transport for our country is the transit on the waterways on the Danube. Thus, along the Romanian Danube sector (1075 km) and the Danube – Black Sea Canal is ensured the connection between the Danube and Constanta harbor, the Danube-Black Sea canal shortening the cargo transport distance inwards/outwards the Black Sea towards the Danube Central European ports by 400 km, ensuring the direct connection between Constanta and Rotterdam. Moreover, the Danube, through a suitable operation of its potential will contribute to the integration of Romania in the European Union in a sustainable manner, creating the opportunity for our country to gain the key position for attracting the cargo flows, in the relations between Europe and the other continents.

The maritime and river transport will play an important role in the integration of the home market and will support the emphasize of the geographical position of Romania as a transit zone, being at the crossroads of the pan-European transport corridor IV and the pan-European corridor IX. The location of Romania at the intersection of various ways, which connect Western Europe with Eastern Europe, and Northern Europe with Southern Europe, as well as the location of the country on the transit axes between Europe and Asia, constitutes an element of reference for the determination of the strategic options regarding the development and modernization of the transport infrastructure. The opportunity created by the Danube-Black-Sea canal, the Danube River and the Black Sea Coast can represent a key position for attracting the international cargo flows, in the relations between Europe and the other continents.

An efficient shipping industry based on a suitable management and a transport infrastructure related to the European transport will contribute to the growth of the economic competitiveness and will facilitate the integration in the European economy allowing at the same time the development of new activities on the home market.

3 SOCIAL DIMENSION OF EUROPEAN POLICY REGARDING WATERBORNE TRANSPORT

The social approach of the waterborne transport represents an important aspect of the future development of this activity sector. Oceans and seas, as well as waterways are a source of income through tourism. The direct revenue from maritime tourism in Europe is estimated at 75 billion euros [1]. The tourists, who spend their holidays along the coast, enjoy the sea and the beach in different ways. Regarded/considered from the perspective of the European experience, the tourist activity on the Romanian Black Sea coast should take into account the fact that a lot of European tourist destinations, similar to the Romanian one, owe their popularity to their proximity to the sea and mainly depend on the quality of its environment. A high level of coast and maritime environment protection are essential for sustaining tourism in general and for the rapid development of the eco-tourism branch, especially (the tourist potential of the Danube Delta being unanimously recognized). Tourism can enhance the building of pleasure boats. The shipping sector destined for tourism (including here the cruise ships as well) has expanded in recent years by an annual growth of more than 10%. On the one hand, cruise ships are mainly built in Europe (such intentions on the Romanian market as well in the shipyards of Turnu Severin and Oltenita); on the other hand, the tourism on cruise ships can contribute to the development of the Black Sea Coast as well as the maritime Danube. Various such activities have been carried out in the last few years through the passenger terminal in Constanta port and through the tourist river routes Regensburg-the Danube canal-the Black Sea-Sulina.

The sea plays an important role in the competitiveness, sustainability and safety of energy provision, key objectives identified by EU specialist commissions. The maritime ports on the Black Sea Coast can play an important role for the energy sector being the main transport route for the raw materials: crude oil and liquefied gases.

The offshore eolian energy can also represent a vast regenerating source of energy with various applications in the national economy. Such a policy could further support the economic development and the sustainable creation of work places in this region. Moreover, the European policy in the food domain – Food and Agriculture Organization – says that the latest demand for fish consumption will be taken over by the aquaculture through the offshore cage farming technology.

From another perspective, shipyards provide a very good case study on the way in which the European traditional shipping industry copes with the ever-growing global competition, represented especially by Asia. We can say that from this point of view the Romanian shipbuilding sector adjusted very well to the new challenges in the domain. During the last decay the European shipbuilding companies have reduced the work places by 36%, but have gained 43% in productivity. This happened in a sector specialized in highly complex ship production. Ships built in Europe are remarkable as far as complexity, safety and their effect on the environment, often above the standards imposed by the international conventions in the domain are concerned. The EU shipbuilding industry is still the world leader in shipbuilding technology, all major inventions coming from Europe. As a result, the EU industry has undergone a far greater development than the Far East despite the smaller volume of tonnage produced. The orientation of the home shipbuilding industry in collaboration with traditional European companies towards the building of specialized vessels, with a high level of complexity, will ensure that in future the aspects related to the safety of work places and European standards activity conditions will no longer be a problem.

Moreover, for the remote regions lying along the Danube, we refer here to the areas in the Delta, a better access, including the enhancement of traffic in the area, could consolidate their economic and social development.

4 ECOLOGIC DIMENSION OF EUROPEAN POLICY REGARDING WATERBORNE TRANSPORT

The sustainable development of all economic sectors is the key point on EU agenda [1]. The challenge is to ensure the mutual reinforcement of economic growth, social welfare and environment protection. The ecologic approach of this matter supposes the analysis of the current situation on national level, under the conditions of European integration and the necessity to comply with European standards as far as shipping industry is concerned (waterborne transport, port operation, related services regarding ships and cargoes, etc.) This fact has emphasized that the present situation of the national waterway transport is characterized by an advanced degradation of the infrastructure. Thus, it is imperative to modernize and develop the national waterway transport network at the quality parameters of the offered services. We mainly refer here to the insurance of meeting with the necessities of people mobility and cargo flow regarding the capacity, quality and safety, which should ensure the carrying out of a sustainable development of this sector as part of the whole transport system. Within the priority strategy „The Development and Modernization of the Transport Infrastructure" it is necessary to carry out a balanced development by ensuring a modern and sustainable infrastructure together with an enhancement of quality services and the creation of a functional system of "unity in diversity".

Within the described context there impose a new approach of the waterborne transport-an important factor of the socio-economic development, but at the same time a harmful factor for the environment. This approach must rely on two concepts: the concept of sustainable socio-economic development and the new concept of environmentally friendly shipping promoted successfully in the shipping industries of countries like Norway, Sweden, Denmark, Finland and Germany. While the concept of sustainable socio-economic development does not leave aside the environment economy, changing the method of approach of development matters and defining the environment as valuable under three aspects (aesthetic, ecologic and economic), the latter concept refers to the whole shipping industry, being represented by the international standards in the domain and by a wide range of technical and administrative projects.

5 CONCLUSIONS

The global matters related to the balance of the environment factors become very important within the concept of sustainable socio-economic development through the principle today for tomorrow, all the problems related to resources (air, land, water, pollution and environment degradation) being analyzed interdependently with the socio-economic and technological development. Thus, the sustainable development represents the ability of a national economy to maintain a balance between the social, economic, technical and environmental conditions in the process of development, in other words, the capacity of a national economy to support a sustainable development policy in which consumption and production should be carried out preserving the qualities and resources of the environment.

It goes without saying that for the waterborne transport the analysis of the relation cost-profit represents an important decision-making method based on the evaluation of various advantages but from the perspective of the issue specific for the environment economy the problems of ecologic reconstruction focusing on prevention activities must be approached as well [3], [4]. The contradiction between the environment and the waterborne transport specific economy is revealed by ever-greater ecologic disasters the results of which cannot be stopped but by costly actions of restoring the natural resources/environment (the accident of the Volgoneft tanker in 2007 in the Black Sea)

The integration of Romania in EU and NATO means the acceptance of the sustainable doctrine as the only responsible solution for projecting the development on average and long term, in accordance with the national interest and with the international collaboration requirements. The key problem of the sustainable development not only for Romania is - as the only alternative of ensuring the quality of life-the reconciliation between two human aspirations which sustain the necessity of continuation of the economic and social development, but at the same time the preservation of the natural capital, made up of irreplaceable resources.

In conclusion, we can state that the changing of the perspective in socio-economic development approach, enhanced by the concept of sustainable development, represents in fact „a new attitude towards the complex relation man-socio-economic activities-environment, the broadening of the analysis of the reciprocal influences and causes, as well as the deepening of the relevant domains of study. The new concept considers this report bilaterally, in the context of a global system, which means that both the satisfaction of human needs and the protection and preservation of the environment (of its needs) are equally considered. This is the challenge for the Romanian waterborne transport not only from the perspective of complying with the EU requirements regarding the environment but also from the perspective of the development of this complex sector on sustainable principles.

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AN OVERVIEW OF THE NEW ARHITECTURE OF INTERNATIONAL MONETARY SYSTEM

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Abstract: *The International Monetary Fund and the World Bank represents only a parcel of the institutional system with universal vocation. Its role is to watch over the monetary-financial dimension and it has direct responsibilities regarding formulating certain policies and coherent strategies meant to assure the general monetary and the global financial equilibrium.*

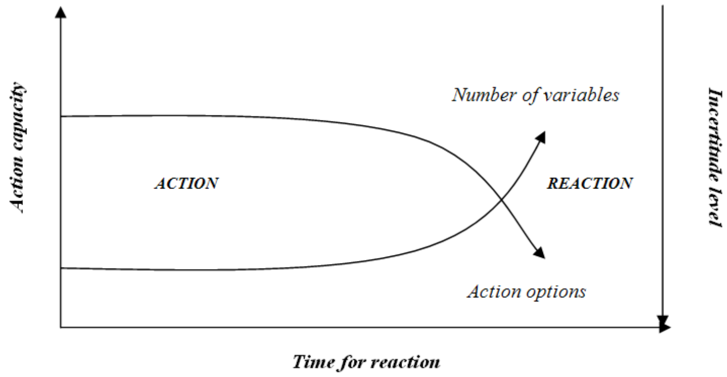
Keywords: *international, monetary, economy, market.*

The new architecture of the international monetary-financial system is determined by the evolution of the economics, socials, culture and contemporary policies. The reorganization of the monetary-financial system’s institutional and functional formulas is not possible against trimming the intervention according to all the attempts regarding defining the new equation of the global equilibrium. The International Monetary Fund and the World Bank represent only a parcel of the institutional system with universal vocation. Its role is to watch over the monetary-financial dimension and it has direct responsibilities regarding formulating certain policies and coherent strategies meant to assure the general monetary and the global financial equilibrium.

As a rule, on the international level, the action directions start from the dynamic evaluation of the major risks. These are intercorrelated and dimensioned according to the decisive geopolitical, geostrategical and geoeconomical panel. In the bellow is a representation of the global function evolution of response when a certain element of uncertainty is clearly shown. The evolution is defined considering the action time and free reaction space which the universal systems would get. Following the international monetary-financial system patterns, this graph can be translated by noticing a reversed proportion interconditioning relation between the action capacity and the disposal time response of the international financial authorities and its operational efficiency. This happens due to the exponential increasing of the number of variables implied, when a risk parameter related to the international monetary-financial markets is being present.

Rationally, the problem resulted analyzing this graph is related to the adequate relatively time needed for elaborating the supervision and governing policies for monetary-financial equilibrium assuring. The equilibrium is also in a reversed proportional relation with the available time for wording a reaction onto the market. Thus, taking in consideration the concentration of the markets (*markets concentration*) in time and space, wording the reaction is more difficult because the action space is propitious only for ,,*crisis prevention*” phase.

The preventing actions occupy the main position in describing the specific market risks manifestations. The strategic options can only be concentrated on the account of reducing the number of variables afferent to the internal or external functional environment of the markets.



Graph No.1*

Thus, if there is not enough time for elaborating an adapted reaction, implementation of the preventing and supervising background becomes compulsory.

In this order, when a simple deviation or functional side-slips will with interfere, the indicators shall be distinctively delimitated and treated before the whole system is affected.

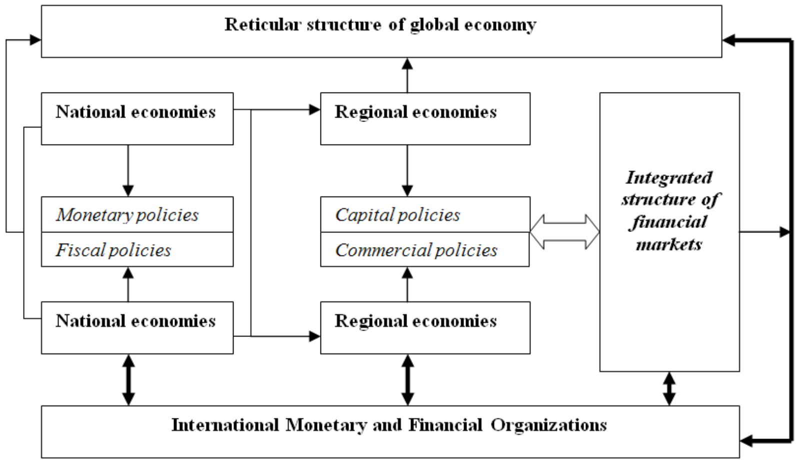
Nowadays, the national economies represent themselves as centers of heterogeneous evolution which induces a series of risks and uncertainties to the system. These are defined by particular variables, not only in economically or financial area but also from geopolitical and geostrategical point of view. On the account of these centers of heterogeneous evolution some unique aggregate variables are being defined based on the *global → national* relation and not the other way around, as it would make sense, based on the *national → regional → global* algorithm. According to the graph no.1, defining a functional structure is compulsory. It must be grounded on the necessity of increasing the number of variables and on the *national → regional → global* relation so that the possibility of enlarging the curve of possibilities for subsequent reactions in the „*treating*" phase of crisis would exist. Furthermore, the example of defining the European Union space, represents the most eloquent successfully proof on the international scale. This happened by gathering countries around certain regional centers based on global realities building, starting with the regional integration. Thus, starting with the general difficulties caused by the great spread of the environmental variables and the comprehensive concentration in time and space terms, the new architecture of the international monetary system must be constructed based on 2 main pillars, such as: the defining of a common conciliated networking configuration of the national economies and the elaboration of a functional structure of the global markets under an integrated perspective.

In the current stage of the world economy, every nation tries to adapt its economy to the new ***given*** realities by following the demands established through the results of the international cooperation and the decisions worded at the level of the greatest economical powers. In this way, the emerging countries destinies are tributary to promoted interests and preferences of this privileged group of states. In spite of fact that this meters concern all of us, the variables are predefined by the exclusively arbitration of the developed countries. Unfortunately, for these countries the market game has different meanings than the global overwhelming problems in terms of poorness, organized crime or the environment pollution.

Starting with the principle according with the equilibrium of a system can be governed efficient only through the equilibrium of the parts, we can concluded that the international monetary system could become impossible for a global governing, in terms of action heterogeneity possibilities on the regional level. Global economy configured as a ***functional network***, should emphasizes the particular perspective of a modern world economy, where the states are integrated in an equitable system own to a fair distribution of capitals exclusively based on absolute and comparative advantages theories. This proposed new architecture should be built starting with a functional structure of a global informational network for data correlation on an international level, having as primary purpose, the global variables defining. In this order, the coherent market reactions, within this kind of network, can be assured only by assuming a generalized global responsibility, consolidated around the main recognized principles of macroeconomic policies. The results of this plus in flexibility should be found in terms of time, within the enlarged broadband of regional reactions and, further, in the consistency of global reaction formula.

The major difference between the international economies heterogeneous characteristics and the reticular network configuration of global economy consists in the possibility of a direct involvement in the decision process and not only in the cooperation stage or assistance procedures. Considering this, as a priority, the state interests must be assimilated and harmonized with the general interest in terms of *national → regional → global* relation. All of these have to contribute in defining process of some system variables specialized and personalized on countries and different regions for further developing of an international early warning system. Developing some informational networks that are regionally integrated will give the opportunity to increase the speed reaction based on the initial decreasing of the variables number and on the restraint of the treatise spaces. Thus, the European Union example, offers a background of a possible regional common settlement, from the economical, monetary or social convergent policies. It also offers a political discussions forum, grafted on collective participation meant to stimulate the decreasing of the environment variables (regarding the predictability of policies, single currency and integrated markets), favoring the action unity and a coherent intervention attempts, within the assurance of the regional and, further and global equilibrium.

In a different order, the states have on their disposal a large set of monetary and financial policies, used for governing internal variables of environment, such as: the economic growth, the inflation, the budgetary deficit or the currency rate. Taking under consideration the major impact of the capitals free circulation against those indicators locally governed after the classic policies, we can suggest that there are missing exactly the specific governing instruments of the relation between the internal national or regional indicators and the external pressures. According to the relations suggested in the graph no.2, the monetary and the fiscal policies must be completed by a set of ***capital policies***. This policy set must be able to offer the opportunity for controlling the internal indicators in relation with the particular evolution of the capital flows (agents of fusion) on a regional and international level. If capital influxes are freely left, as neoliberale thesis emphasize, without a regional harmonization, there cannot be established an accurate report between the immediate national interest opposite to investors aims and the *free market* principles.



Graph No.2

As it has been shown, in the international practice, the macroeconomic indicators (intensely detailed and defined by the economical theory), have different evolutions. Their evolution is based on the national and regional characteristic features regarding economical, social, political and cultural or strategically points of view. Even more, the heterogeneity of this indicators evolution becomes more obvious since the capital flows have been liberalized and new dilemmas and challenges have been corresponsive appeared, determined by the pertinent necessity of macrostabilization. On the other hand, these consequences are embedded by the imperative need of maintaining the minimum external standards regarding the market image or perception. The transmission of the crisis contamination cannot be stopped by isolating economies with problems. It can be reduced only through a precise preliminary delimitation of the affected sectors and thus by interrupting the propagation channels of the crisis on these segments. The contagious affection of the health states placed in a unequilibrate region, justifies the necessity of a national economies preliminary integration, first in regional structures and second in a global perspective.

For example, if we take under consideration the inflation phenomena on the macroeconomical level from the perspective of the classical theory, its evolution can be reduced. Normally, this can be done through the interests rate controlling or through sustainable policies for national currency protection against the main foreign exchange rates volatility. In spite of the neo-liberal theory about maintaining the freedom of foreign capital inputs and outputs, the interest rate burst and the depreciation of the currency can determine the premises of huge speculations coming from the greatest financial corporations. An eloquent example is offered by Stiglitz J. who is mentioning the technique of the repeated speculative attacks over the main Asian currencies. The result was the collapse of the currency exchange rates by taking under consideration whether they had, or not, sufficient reserve currency to remunerate these speculations at the right time. The creditors of currency of those state who borrowed a currency being in a full process of depreciation, will have the interest to stimulate its immediate failure. This kind of speculative actions has been executed very often in last three decades and the states, depending on heir financial power, reacted different. For some states record a quick stabilization (e.g. South Korea) based on their great reserve currency, while others, opposite in terms of financial power, succeeded just to increase their debts with no possibility of establishing an equilibrium in short time (e.g. Indonesia, Thailand). In background, through its substantial direct interventions, International Monetary Fund has been feed in fact these speculations, by speeding up the national currencies depreciation on the vicious spiral of uncertainty.

Therefore, adopting and forcing through their policies and actions the Washington Consensus "*free market*" rules, International Monetary Fund, has been acted against the national interests, subordinating the local macroeconomical imperatives and priorities to the speculative market game. In case of a reticular structure of the national economies, in a crises situation, the IMF's intervention could be directed exclusively to the affected segments without any distortions of market image for states in troubled and without aggravating the markets reactions. In the given example this fact could be expressed by the agreed intervention of the fund. The priority is to accomplish an immediate stabilization of the markets but not for directing the macroeconomical policies of the affected states. In terms of promoting a reticular structure, the economies will succeed only adopting or negotiating common regional policies related to the capital flow policies. This new policies shall be transparent and shall be based on medium and long term in relation to the expected crisis effects.

As an idea, creating some *global centers of collecting and interpreting* the risk factors, may offer a real consistency to the global attitude idea as long as all those who are present on the market are involved in this action. Also, creating an international institution of the post-crisis reforms arbitrage may cointerest the creditors to participate effectively in the reorganization of the countries affected by the crisis. In this order, the collecting and evaluating the risks would be called in the phase of stability to harmonize the global informational system in relation to the heterogeneous macroeconomical realities. In this way, when are launching crises, a macroeconomical common answer shall be, in time, coherent formulated. The answer will be adapted to the international markets reactions. Creating new institutions does not occur in the famous perspective of J. Stiglitz over the reform process ("… the mountain gave birth to a little mouse") but it certifies the idea that the equilibrium process of the financial system, involves the international negotiations including extremely laborious and bureaucratic steps. As long as this situation lasts it can be said that supervising the markets is firstly a political problem that needs to be treated as such. No matter how many technical organisms will work; finally, the political side and the administration institutions of the consensus will be the most important. On the contrary, avoiding or neglecting the political dimensions, will permanently maintain speculations regarding the lack of efficiency of the international financial institutions.

The market stabilization can be done either from an informational point of view, through detailed calculation of loss, on risk categories and by setting the rational market action limit (courtesy of that global centre of collecting and interpreting risk factors), or by subsidizing short-term loss (e.g. aided by derivate promissory notes), conditioned by reforms negotiated and accepted on the market. As a suggestion, these reforms could be negotiated inside a international crisis arbitration forum, that would function similarly to the example provided by company restructuring processes: country in trouble proposes a rehabilitation plan and creditors, jointly interested, help structural adjustments through reforms (new business opportunities, based even on a potential *pre-emption* right).

The right moment for action, from the IMF and WB point of view, is the moment when markets are steadying, and can be marked by involvement in arbitration orders, offering the solicited technical or financial support, but less for correcting some short-term monetary formulas, and more in the purpose of stimulating real economy. In the IMF and WB case, these interpretative aspects (sometimes maybe too simplified, for reasons enforced by generalization), justify the strategic shift in preference toward a global surveillance, defining the conduct-related boundaries frame, based on equitable management of consensus, assuming responsibilities regarding the financing of durable development, on a global scale.

The main characteristic of the reform process is, basically, acknowledgement of the necessity to reestablish the two specialized institutions as foundation elements of the institutional political system, on whose account they have been created – these five strategies, in fact, setting the premises for a rebound of representatively, utility, efficiency and relevance principles, looking at world expressed trends, expressed in the Monterrey Accord (United Nations – Department of Economic and Social Affairs, Mexico, 2002). The desideratum of having the two institutions' integrated within global consensus, administrated by the United Nations System, has moreover been stated officially through the U.N. Resolution No 61/253 dating on the 8th of August 2006, concerning implementation of the Conference's results in the sense of financing Monterrey's development program.

As specific actions, what stands out are: strategies on reducing poverty, technical and financial assistance on structural adjustment, the support of social projects or assistance on strengthening the response capacity to international economies opening. Sustaining the system of attracting financial support, based on projects or "grant"-s, contributes to the transparency of the monetary-financial organizations, but the lack of strategy competition and regional priorities creates the premises of inadequacy towards the requirements of steady development. The IMF and WB need to get more involved in attempting a fruitful cooperation between mid-developed countries and pointing macroeconomic policies towards progressive coping with the values of globalization, and not by shock-therapies. Implementation of regional strategies can be helpful in "exercising" the principles of free market, between states of equal size and caliber, decisively lending a hand to acquiring breathing space necessary for finding the flaws in national economies, calcifying their own institutions and elaborating strategies that adapt to total openness of the economies towards international capital flows.

Conclusively, the new face and body of the international monetary-financial system may be shaped first by applying major reforms to the present political consensus situation, with the participation of all states in the process of setting the right strategies and policies in order to achieve intercommunity, under globalization and economic integration. Regionally, the latter presently appears to be the first logical step in defining a global system. The experiment of European integration and the positive results from Central and Eastern European countries, much better when confronted to crisis situations, is itself hard evidence that the metamorphosis into a global system must be divided into integrative regional steps, that later should be possible to combine into a coherent, functional system – with enough exercise in sharply pointing out the right direction of action. Once politically "stimulated", the globalization process, through regional integration, can lead to the reticular development of the global economy and might just mean the “fresh breath of air” for many growing countries, in their collation with the Great Powers. The responsibility carried by highly developed countries towards the ones less so, who retain majority by their demographic strength and their incidence over systemic risk variables, is overwhelming, and the success of the new economic and financial “design” of the world relies, after all, on the way in which this group of states chooses to involve in shaping contemporary global relations.

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