OPTIMIZATION OF TRAINING SHIP "MIRCEA" UNDERWAY ON ROUTE CONSTANTA TO NEW YORK

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Abstract: The subject of this paper presents the optimization and safe execution of the training ship Mircea underway, between Constantza Port (Romania) and New York Port (United State of America), with a stoper for refueling.

Training Ship "Mircea is a sailing – ship; she executed three ocean pass. The first one was in 1976, then in 2004 and the last in 2009. The last ocean pass lasted 40 days, when traveles 4700 miles marine. During the paper were studied navigation maneuvers in bad weather, the hidrometeorological condition during the march, the ways to execute safety the ship maneuvers input/output to/from port, passes through the straits, narrow passages or low visibility.

Key words: march, Constantza, New York, sailing-ship, ocean pass

Describing the underway ocean pass of training ship "Mircea"

Training Ship "Mircea" is a sailing ship. The ship executed three ocean pass: the first one was in 1976, then in 2004 and the last in 2009.

In 1976, the training-ship "Mircea", became the first ship in the Romanian Navy that performed the crossing of the Atlantic Ocean. The march started at March 4th and finished at August 30th.For 180 days the crew sailed 19.549 nautical miles from which 52 days with sails. The harbors where she stationed was: Las Palmas, La Guairá, Cartagena, Veracruz, Havana, Hamilton, Newport, New York, Baltimore, Philadelphia, Lisbon and Alger.[9]

The march executed in 2004, between April 19th and September 26thremained memorable. The ship participated at the nautical competition "TALL SHIPS CHALLENGE 2004", organized on the east coast of the United States of America and Canada. For 160 days, the 190 members of its

crew sailed 15.000 marine miles and represented Romania in 13 harbors: Cagliari, Las Palmas, Hamilton, Charleston, Baltimore, New Port, New London, Halifax, Arichat, Sydney, Brest, Cadiz, La Valleta.

During April 12th to September the 1st2009, the training ship executed a training march in the Black Sea, Mediterranean Sea and Atlantic Ocean, with port of calls in Catania (Sicilia-Italy), Cadiz (Spain), Tenerife (Canare Islands-Spain), Hamilton (Bermuda Islands), Charlestone (South Carolina-U.S.A.), Boston (Mariland-U.S.A.), Ponta Delgada (Azore Islands-Portugal) and Mellila. On this occasion training-ship "Mircea" took part to the Regatta "TALL SHIPS CHALLENGE 2009", and to the "BOSTON SAIL FESTIVAL".



Fig.1. Route underwayfrom Constanta to New York

Descrition of the route from Constanta to New York

In this paper is presented the optimization and safe execution for the following underway training ship Mircea, between Constantza Port (Romania) and New York Port (United State of America), with a stoper for refueling. The port chosen for refueling is Cadiz (Spain).

The nautical documentation used create a exactly area which be crossed, navigation hazards and recommended roads.

The map corrections or additions are part of the information obtained from these consultation documents. Pilot books contain very useful information on the description and possibilities of recognition of the coast, as well as landmarks for navigation. If some information from these documents are inconclusive or contradictory, it is considered correct those that are more recent.

The nautical charts[4] used for execute a safety march:

Table 1. Map number and map designation[6]

Nr	lap Nr.	Map designation	
1.	87	Cabo Finisterre to the Strait of Gibraltar	
2.	89	Cabo de Sao Vicente to Faro	
3.	91	Cabo de Sao Vicente to the Strait of	
		Gibraltar	
4.	142	Strait of Gibraltar	
5.	165	Menorca to Sicilia including Malta	
6.	176	Cap Bon to Ra's At Tin	
7.	180	Aegean Sea	
8.	183	Ra's at Tin to Iskenderun	
9.	224	Marmara Denizi	
10.	252	Cap Corbelin to Cap Takouch	
11.	773	Strait of Gibraltar to Isla de Alboran	
12.	774	Motril to Cartagena including Isla de	

		Alboran		
13.	1004	Canakkale Bogazi to Marmara Adasi		
14.	1005	Marmara Adasi to Istanbul Bogazi		
15.	1015	Southern Approaches to Istanbul		
		Bogazi		
16.	1030	South-West Entrance Channels to the		
		Aegean Sea		
17.	1037	Nisis Falkonera to Nisos los		
18.	1038	Steno Sifnou to Steno Kafirea		
19.	1041	Nisos Naxos to Vrakhoi Kaloyeroi		
20.	1058	Nisos Khios and Izmir Korfezi		
21.	1061	Candarli Korfezi to Edremit Korfezi with		
		Nisos Lesvos		
22.	1086	Edremit Korfezi to Strimonikos Kolpos		
23.	1087	Steno Kafirea to Edremit Korfezi		
24.	1091	Nisos Kriti		
25.	1092	Western Approaches to the Aegean		
		Sea		
26.	1093	Steno Andikithiron to Steno Kafirea		
27.	1095	Steno Kafirea to Rhodes Channel		
28.	1158	Istanbul Bogazi Kuzeyi		
29.	1159	Istanbul Bogazi Guneyi		
30.	1195	Anchorages in the Southern		
		Approaches to Instanbul Bogazi		
31.	1198	Istanbul Bogazi		
32.	1439	Sicilia to Nisos Kriti		
33.	1440	Adriatic Sea		
34.	1448	Gibraltar Bay		
35.	1608	Approaches to Canakkale		
36.	1909	Ile Plane to Cherchell		
37.	1910	Cherchell to Bejaia		
38.	1912	Ports on the North and West Coasts of		
		Morocco		
39.	1941	Capo Passero to Capo Colonne		
40.	1950	Arquipelago dos Acores		
41.	1983	Capo Carbonara to Capo San Vito		
42.	2121	Cap De Fer to Iles Cani		
43.	2122	Bizerte to Capo San Marco		
44.	2123	Capo Granitola to Capo Passero		
45.	2124	Isola di Lampedusa to Capo Passero		
		including Malta		
46.	2214	Black Sea including Marmara Denizi		

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1		and Sea of Azov		
47.	2230	Constanta to Kefken Adasi		
48.	2232	Constanta to Yalta		
49.	2282	Plans in Romania		
50.	2284	Portul Constanta and Approaches		
51.	2429	Canakkale Bogazi		
52.	2437	Ras Tarf to Oran		
53.	2456	Nantucket Sound Western Part		
		Buzzards Bay and Approaches		
54.	2489	Nantucket Sound Eastern Part and		
		Approaches		
55.	2492	Bay of Fundy to Block Island		
56.	2666	Grand Banks of Newfoundland		
57.	2670	Cape Breton to Delaware Bay		
58.	2717	Strait of Gibraltar to Barcelona and		
		Alger including Islas Baleares		
59.	2754	Fire Island Inlet to Block Island Sound		
		including Long Island Sound		
60.	2755	Approaches to New York Harbour		
61.	2860	Outer Approaches to New York		
62.	2890	Approaches to Narragansett Bay and		
		Buzzards Bay		
63.	3132	Strait of Gibraltar to Arquipelago da		
		Madeira		
64.	3204	New York Lower Bay and Approaches		
65.	3456	New York Upper Bay The Narrows to		
		Governors Island		
66.	3459	New YorkLower Bay		
67.	3578	Eastern Approaches to the Strait of		
		Gibraltar		
68.	3681	Kriti-Western Part		
69.	3930	Northern Approaches to Istanbul		
		Rodozi		
70	4000			
70.	4000	The World		
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70. 71. 72.	4000 4002 4004	The World A Planning Chart for the Pacific Ocean A Planning Chart for the North Atlantic		
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NP202 Volume 2, Europe (excluding United Kingdom and Ireland), Mediterranean Sea and Atlantic Ocean ALL NP77 Volume D: Eastern Atlantic Ocean, Western Indian Ocean and Arabian Sea; from Goulet de Brest Southward, including offlying Islands, to longitude 68° East ALL NP78 Volume E: Mediterranean, Black and Red Seas ALL NP81 Volume H: Northern and Eastern Coasts of Canada; including River Saint Lawrence and Saint Lawrence Seaway NP82 Volume J: Western Side of North ALL Atlantic Ocean; from Maine to Cabo Orange, including Gulf of Mexico and Carribean Sea ALRS6 NP286(2) Volume 6 - Part 2, Pilot Services, Vessel Traffic Services and Port Operations (Europe - excluding UK, Ireland, Channel Ports and the Mediterranean) ALRS6 NP286(3) Volume 6 - Part 3, Pilot Services, Vessel Traffic Services and Port Operations (Mediterranean and Africa - including Persian Gulf)

ALRS6 NP286(5) Volume 6 - Part 5, Pilot Services, Vessel Traffic Services and Port Operations (North America, Canada and Greenland)

To execute the route, the voyages was divided in 8 steps:

Step 1 – Constanta Port to Bosphorus • Strait

The ship start departure from Constanta Port on 2016, June, 25th/ 10:00,and join the traffic separation scheme.[1] The average speed for this part of route is 10 knots, the distance executed before arrive to Bosphorus Strait is 170 Nm. After depart from Constanta, the ship took a course of 170⁰.

The ship continues by crossing the Black Sea and moves towards the Bosporus Strait. The ship joins on the traffic separation scheme from entering the strait and on June, 26th/ 00:32when she willambarch the pilot to transit the strait.

In this case, if we choose to navigate with sails on the distance between Constanta and Bosphorus Strait, the ship would have entered in Bosphorus Strait at June, 25th/ 23:32.

In tabel 2, are presented the weather conditionin Constanta harbour on June, 25th, 2016[7].

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Tabel 2. Meteorological condition in Constanta				
Max Average Min				
Temperature				
Max Temperature	33 ⁰ C	31 ⁰ C	27 ⁰ C	
Mean Temperature	26ºC	25°C	23°C	
Min Temperature	21°C	20 ⁰ C	19ºC	

Other nautical documets that may be used:

Degree Days			
Heating Degree Days 0			
Cooling Degree Days	14	13	8
Growing Degree Days	29	27	23
Dew Point			
Dew Point	22ºC	18ºC	14 ⁰ C
Precipitation			
Precipitation	0.0mm		
Wind			
Wind	27km/h	14km/h	3km/h
Sea Level Pressure			
Sea Level Pressure	1015hPa	1011hPa	005hPa

• Step-2. Transit Bosporus strait

Transit the Bosporus strait will be executed on 26^{th} of June between 00:32 and 01:17 hours, observing the rules under "Extras Regulation maritime traffic through the Bosporus – Dardanelles Strait Marmara Sea" and speed restriction of 10 knots when imposed during transit. During the transit, the ship took a course of 175° - 180° .

Fairway extending over the area defined by the line joining Headlamp Anadolu and Headlamp Rumeli to the north, the line joining Headlamp Ahikkapi and Headlamp Kadikoz Inch Cape south and the outer limits of passes.



Fig. 2.Underway Constanta harbour to Cadiz harbour[8]

• Step-3- From Bosporus to Dardanelles

Ship ending transiting the Bosphorus Strait on June, 26th/ 02:47 when begins the march in the Marmara Sea, with an average speed of 10kts, general course 183⁰. The marchin Marmara Sea ends at03:41 and after obtaining the approval of the Centers traffic control AHIRKAPI (north entrance to the Dardanelles), continues the march for crossing the Dardanelles Strait. Using the sails, ship would have ens the march in Marmara Sea at 02:06, with a speed of 12-13 kts.

After getting approval from the Centre traffic control AHIRKAPI, the ship continues to transit the Dardanelles strait strarted from June, 26th/ 03:41, respecting the rules under "Extras Regulation maritime traffic through the Bosphorus Dardanelles Strait and Marmara Sea ". The general course : 260⁰, average speed: 10kts using the engine.

The navigation in Dardanelles represents the area between the line connecting the Headlamp Cape Mehmetcik and the Headlamp Cape Kumkale in southwest, the Headlamp Gelibolu to the Headlamp Cardak to the northeast, and the outer limits of the aisle navigation of the Dardanelles Strait.

Tabel 3. The weather in Istanbul on 26th June

	Actual	Average	Record	
Temperature				
Mean Temperature	27 ⁰ C			
Max Temperature	31ºC	28ºC	32ºC	
Min Temperature	23 ⁰ C	21ºC	16ºC	
Cooling Degree Days	17			
Growing Degree Days	32			
Moisture				
Dew Point	19ºC			
Average	64			
Maximum Humidity	78			
Minimum Humidity	30			
Precipitation				
Precipitation	0.0mm			
Wind				
Wind	15km/h			
Max Wind Speed	26km/h			
Visibility 10.2 km				
Sea Level Pressure				
Sea Level Pressure	1011.25	hPaa		

• Step 5. Transit Mediterranean Sea

After transit the Dardanelles Strait on June 26th/ 13:53 the ship continues the march toward the Gibraltar Strait via the Greek archipelago, with a general course of 243° for half an hour, then change it to 233° . The approximately course for transit the Mediterranean Sea is situated between $230^{\circ}-270^{\circ}$. Before enter in Mediterranean Sea, the ship sailed 305Nm.

Using the sails, the ship would exit from Dardanelles Strait at 09:57.

Step 6 -Cadiz Port

In this study case, I choose to make a stop in Cadiz Port for refueling, after pass the Gribraltar Strait.

• Stage-4 - Transit Dardanelles Strait



Fig. 3. Ship underway to Cadiz[8]

The ship enters in the Atlantic Ocean and continues the march to Cadiz Port. On July 02nd/ 14:53 the pilot is embarked on board and begins maneuvers for port entry.[5]The ship enters in port on July, 02nd/15:45 and is stationed for 3 days. In case the ship used the sails to transit the Mediterranean Sea, the average speed should be12-13 kts, that means the ship would have reached in Cadiz around 03:48. Until now, the ship runs 2089 Nm.

			-
	Actual	Average	Record
Temperature			
Mean Temperature	22°C		
Max Temperature	26°C	26°C	35°C
Min Temperature	Min Temperature 17°C 18°C 13		13ºC
Cooling Degree Days	5		
Growing Degree Days	20		
Moisture			
Dew Point	18ºC		
Average Humidity	80		
Maximum Humidity	100		
Minimum Humidity	54		
Precipitation			
Precipitation	0.0mm		
Wind			
Wind	8km/h		
Max Wind Speed	24km/h		
Visibility	6.0 km		
Sea Level Pressure			
Sea Level Pressure	1016.85	hPa	

Tabel 4.The weather in Cadiz on 02nd Ju	y
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Fig. 4. Temperature, barometric pressure, wind speed and wind direction during the day in Cadiz

• Step 7 –From Cadiz Port to New York Port. Atlantic Sea passage cross

After rest for 3 days, on July, 05^{th} / 10:00the ship starts depart maneuverfrom CadizPort. The pilot depart at 10:50. When the ship reaches the point of coordinates $\varphi = 35^{\circ} 52.598$ 'N, $\lambda = 007^{\circ} 36.785'$ W, starts to execute the sea passage cross. The general course for cross is 240°-270° withan average speed of 10 kts using the engine. During cross, the vessel passes between the islands of Sao Miguel and Santa Maria from the Azores.The passage cross end in point of coordinates $\varphi=40^{\circ}29,4N$, $\lambda=073^{\circ}11,6'W$. The ship executed a total of 3113 Nm and then take the general course 275°.

• Step 8 - New York Port

On July, 18^{th} / 18:25 the ship joins the separation scheme traffic near the port of NewYork. The ship calling in at 23:23, the current day.

The general weather condition when the ship arrive in New York are presented in Tabel 5 and Fig.5.

	Actual	Average	Record
Temperature		•	•
Mean Temperature	27°C	25°C	
Max Temperature	31ºC	29ºC	37°C
Min Temperature	23°C	21ºC	14ºC
Moisture			
Dew Point	22°C		
Average Humidity	79		
Maximum Humidity	94		
Minimum Humidity	63		
Precipitation			
Precipitation	15.75mm	4.06mm	4.06mm
Wind			
Wind	5km/h		
Max Wind Speed 32k		1	
Visibility	11 km		
Sea Level Pressure			
Sea Level Pressure	1013 h	Pa	

Tabel 5. The weather in New York on 18th July









Fig. 5. Temperature, barometric pressure, wind speed and wind direction during the day in New York

In the following, considering the way of ship kept constant and the distance beetween Cadiz and New York not very shorter, I calculated the ortodromic and loxodromic distance. The curve of the Earth's surface which cuts all meridians at the same angle is called the loxodromic line. Great arc that connects two points on the ground surface of the sphere is called ortodromic circle.

Starting point:	φ ₁ =35°52,5N	λ ₁ =007º37,8' W	
Finishing point:	φ ₂ =40°29,4N	λ ₂ =073º11,6' W	
Ortodromic, lox	odromic calculat	ion	
Ortodromic calculation (M)	cosM=sinφ1sinφ2+ osφ1cosφ2cosΔλ	^{.c} 3032,8Mm	
Loxodromic calculation (m)	tgD=Δλ/Δφc m=ΔφsecD	3115,5Mm	
Difference between ortodromic and loxodromic distance	C=m-M	82,6 Mm	

Tabel 5. Calculation of ortodromic-loxodromic distance between Cadiz and New York

When the distance between the starting point and the finish point is relatively small (as for example in the case of navigation in the Black Sea, the Mediterranean or the Red Sea), the difference between the distance loxodromic line and ortodromic circle distance is practically insignificant. If, however, the distance between the starting point and the finish is high and points are positioned to a big difference in longitude, as in case of crossing the difference between the distance loxodromic line and the ortodromic circle be considerable: in this can case, if hydrometeorological factors not otherwise require to reduce distance, is sailing on short loxodromic line connecting waypoints of the ortodromic circle. This way to navigate between two widely separated points is called circular sailing (navigation ortodromic). Navigation along the ortodromic circle is virtually not possible, since it requires a continuous change in the way the ship.



Fig. 6. Wind regime in Atlantic Occean

To carry out the march between Cadiz and New York, the ship usesengine propulsion. Covering the distance at a speed of up to 10 nd was carried out in 13 days and 13 hours.

Adjustable single speed and direction of marine currents and wind, the vessel can change the speed. In the Fig.6 are presented the winds and the currents in the Atlantic Ocean. The ship can develop a speed of up to 13 knots using sails. This thing making it possible to reduce the time of arrive at New York and also reduce the cost of march. For travel on the route established most important currents are: the Canary Current and North Equatorial Current.

Between $30^{\circ}N$ and $40^{\circ}N$ the prevailing winds are southerwesterly over the western half and northerly over the eastern half. Average wind speeds south of $40^{\circ}N$ are force 2 to 4. Over Mediterranean waters, northwesterly winds of force 2 to 4 are most common while over the Gulf of Mexico and the Caribbean the prevailing easterlies average force 2 to 4 over the Gulf and force 3 to 5 over the Caribbean.

Preparations for bad weather

Althought the weather in this part of the year it is good, we must consider the posibility of navigation in bad condition. If will be more cautious and take the time all appropriate safety measures, more it will be better. It should be consider that we have a young crew on the ship school, always new, that surprised by dangerous situations they could loses concentration and the orders given in bad weather require more time than in ordinary circumstances.

While good weather, winding and binding siles to both sides are necesary with about 5 minutes, to wrap and tying a sails on bad weather lasts one or two hours or more.

"Hold on tight" must be stretched in time. The crew has where to hang on the slippery and sloping bad deck. At night, in bad weather, unsafe (changeable) must extend all "life line". "Hold on tight" once can be closely only the comand of officer on watch.

Everything must be bitter. Controls will be detailed in this regard.Wind doors remain open only as long as water does not enter in the room because the exit of the crew must done as soon as possible. Took care of the sailors onboard service cart and rain suits have the time before the start of the rain.

Conclusion

To execute the underway route between Constanta Port and New York Port, the ship leave on June25thfrom Constanta and arrive on July18thin New York. The period planiffied for the underway route was June-July when the weather was friendly for navigation. In case of using the sails, the ship arrive 3 days before. The total distance executed is 5328 Nm, started with Constanta harbour and finished with New York harbour. During the sea passage cross, the ship used ortodromic navigation.

During march, the ship respect the rules referes to separation scheme, engagement rules, collision regulation and command orders.

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