네트워크 모형화에 의한 최적 항로 결정

이희용*, 김시화**

On the optimum ship routing by network modeling

Hee-Yong Lee*, Si-Hwa Kim**, Jae-Uk Song**

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Abstract

Optimum Ship Routing can be defined as "The selection of an optimum track for a transoceanic crossing by the application of long-range predictions of wind, waves and currents to the knowledge of how the routed vessel reacts to these variables". This paper treats the methodology how to solve optimum ship routing problem by network modeling and reveals the validity of the network model by some numerical experiments.

1. Introduction

Optimum Ship Routing can be defined as "The selection of an optimum track for a transoceanic crossing by the application of long-range predictions of wind, waves and currents to the knowledge of how the routed vessel reacts to these variables". [6]

The primary goal of ship routing is to reduce a voyage cost in various aspect and keep safe during the period of vessel underway.

From ancient times, a captain has been selecting the best route considering the weather characteristics such as prevailing wave, wind and current status in specific season and area.

For a long time. the oversea trade in korea with china and japan was done through the coastal waters, and especially Hugh addressed in his literature that the SILLA dynasty promoted and kept a brisk trade with japan and china through the weather routes from the 8th century A. D. to the 9th century A. D.[29]

In the occidental history, they say that the first organized attempt at ship routing was made by

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* Ph. D. President of MIT Co., LTD

** Prof. of Korea Maritime Uni.

Matthew Maury in 1847. The first shipmaster to follow Maury's wind and current charts completed a round trip from Rio de Janeiro to NewYork in one half the time previously required.[6]

In this paper the optimum ship routing problem is formulated as a network model and solved by a modified depth-first search algorithm. Some result of numerical experiment is also presented.

2. Optimum ship routing Problem

On a spherical surface of the earth, the shortest path from a departure point (X_s, Y_s) to destination point (X_d, Y_d) is to sail along the Great Circle connecting two points. If there exist heavy seas around a great circle route, to sail along the route on a calm sea can save voyage time.

The optimum route connecting two point is to be determined by the function of the extent of obstruction and a distance between two points.

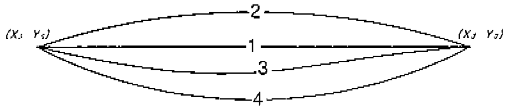

Figure 1. Some paths connecting tow points

A determination of an optimum ship route is to select the best route among a number of candidate routes which minimize a cost such as sailing time, fuel consumption, etc considering weather condition. Decision variables of the problem are to be a control of course and speed.

The kinematics of ship under sailing can be described as the function of a time and position[2]. The voyage cost is to be determined by ship's position P, control variable for engine power and course C, and time t. The port cost B is to be determined by arrival time t_f. With these components of a cost, the ship routing problem can be described by the formulation (1).

Minimize :

$$I = \int_s F\ (P, C, t)\ ds\ + \omega B(t_f) \text{ ---- } (1)$$

$F\ (P, C, t)$: a function of voyage cost for position, control and time

t_f : arrival time at a destination port.

$B(t_f)$: A function of port cost for arrival time

ω : a weight for port cost to be reflect in voyage cost

where, $P \in R$, $C \in C_A$

Regarding Ship Position P, Control Variable C as a function of time t, then the optimum control $C^*(t)$ which minimize cost I determines the optimum route $P^*(t)$. A cost per unit distance ds is measured by sailing time, fuel consumption and the degree of ship safety under sailing.

Where ω is 0, it means that a port cost is discarded, otherwise ω is regarded as a penalty term in the objective function. Let R as a possible sailing region, then control variable C_A will be a limit of allowable engine power and an extent of course changing.

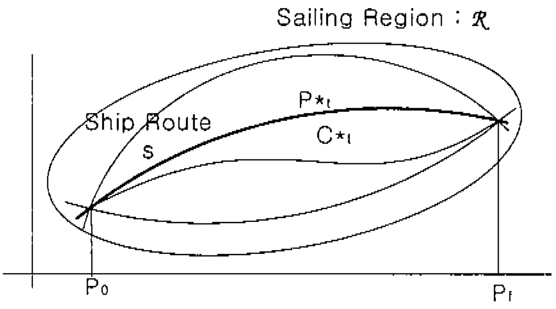

Figure 2 Optimum route in sailing region

3. Literature Survey

The ship routing problem can be categorized into three types according to the solution algorithm, 1) Isochrone Method, 2) N-Stage Dynamic Programming, 3) Calculus of Variation.

Among the recent researches, Hagiwara's one which suggested a modified isochrone method presented a remarkable result suitable to utilize a high computer technology[4]

3.1 Isochrone Method

An Isochrone Line(Time-Front) is defined as outer boundary of the attainable region from the departure point after a certain time(Figure 3). If the weather condition is constant, Isochrone Line will be a part of circle - arc.

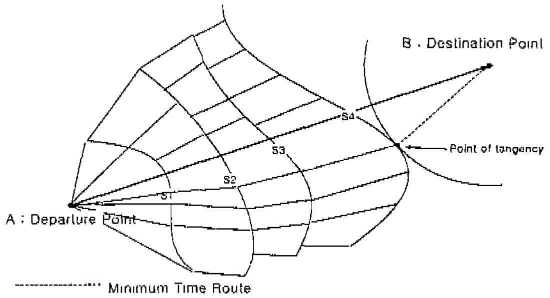

Figure 3. Minimum Time Route

The Isochrone Methods proposed by Hanssen G.L and R.W. James[6] had been used for a long time because it offered an ease manual calculation methods and Hagiwara devised a modified Isochrone Methods suitable for computer programming. The algorithm of Isochrone Methods is as follows.

step 1. Connecting Dep. Point and Arr. Point(Destination Point *B*) with Great Circle

step 2. Make Isochrone Line(S_1) with one day's travel distance considering weather condition.

step 3. Form each point of S_1, draw the next arrival points in another day's travel distance to a perpendicular and connect these points then a second isochrone line S_2 is made.

step 4. Iterate step 3, until reaching Arr. Point

step 5. From the last Isochrone Line S_f, determine the Point of tangency, the nearest point form *B*.

step 6. From the Point of Tangency, connect a line to Arr. point (*B*). And Re-Traverse to Dep. Point to make optimum route.

3.2 N-Stage Dynamic Programming

N-Stage Dynamic Programming uses a Grid System which devides a possible sailing region into several cells. Each crossing points of cell boundary are candidate of waypoints. The solution algorithm of Dynamic Programming seek ship's trajectory which is composed of position $(X, Y, T)_k$, $k=1,2,\cdots,N$ and Control C_k with initial time T_0 and initial ship position.

3.3 Calculus of Variation

Generally, calculus of variation method is applied to a problem to minimize a integral J [24][25]. Let's consider a simple formulation

Minimize :

$$J=\int_{x_1}^{x_2} f(y, y_x, x)dx$$

this problem seek a function $y(x)$ to minimize integral J from x_1 to x_2. In ship routing problem, f is a cost function defined by ship position and time. The calculation result of the function varies from the condition of sea state. The optimum ship route problem solved by method of calculus of variation is to find $y(x)$ which minimize J. [12][13][14]]

4. Network Model

4.1 Network Generation

A network is a special form of a graph which consists of nodes and arcs. A network has numerical parameter such as the length, cost and transit time. [17]

In this paper, a network called "Waypoint Nework" is generated on the base of great circle sailing method to make a practical routes.

4.1.1 Nodes Generation

Nodes in waypoint network are generated with the points which lies on a great circle route and it's neighborhood routes.

To make nodes, at first draw a great circle route between two points. and seek the center point of great circle route. Then around the center point, draw adjacent point around center point in a certain distance. The set which consists of a center point and it's adjacent points are called "A *set of center points*". Connecting departure point and the point in the *set of center points* composes a half great circle routes. Similarly, connecting the point in the *set of center points* and arrival point composes a half great circle routes. An algorithm to nodes generation is summarized as follows.

step 1. seek center point C on the great circle route

step 2. Seek course δ between Dep. Point $X_s(Lat_1, Lon_1)$ and Arr. Point $X_f(Lat_2, Lon_2)$

step 3. Draw a perpendicular δ' to δ, where $\delta' = \delta - 90$ or $\delta' = \delta + 90$.

step 4. Draw the point $c_{\pm i}$ apart from center point in certain distance ζ_i to direction of δ'.

where $\zeta_{i+1} = \zeta_i + \zeta$

step 5. C and $c_{\pm i}$ is a *set of center points.*

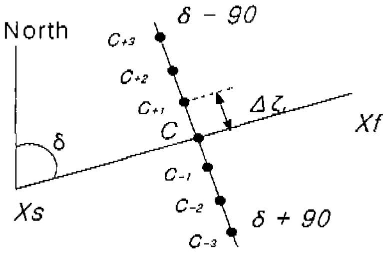

Figure 4. Set of Center Points

Course δ is calculated by the formulation

$\delta = D_{RL} \ / \ l,$

Where, D_{RL} is Rhumb Line distance, $l = Lat_2 \sim Lat_1$: displacement of latitude

Initial Course A_z of great circle route is calculated by the formulation

$$\operatorname{hav} A_z = \sec L_1 \, scs D \, [\operatorname{hav} coL_2 - \operatorname{hav}(D \sim coL_1)]$$

where, $\operatorname{hav} A = \sin^2 \frac{A}{2}$

A_z : initial course, L_1: lat. of dep. point,

coL_2 : co Lat of dep. point, D : Distance

Distance D is calculated by the formulation

$$D = \sin^2 Lat_1 \sin Lat_2 + \cos Lat_1 \cos Lat_2 \cos DL_o$$

The point apart from the dep. point in half distance of great circle distance is calculated by the formulation

$$\sin(D_{gc}/2) = [\sin^2(Lat_2 - Lat_1)/2 + \cos(Lat_1)\cos(Lat_2) \sin^2[(Lon_2 - Lon_1)/2]]^{1/2}$$

And a location (Lat ϕ, Long λ) of a point from a departure point with a certain distance g and initial course A_z is calculated by a formulation

$$\phi = \arcsin(\sin\phi_1 \cos c + \cos\phi_1 \sin c \cos Az)$$

$$\lambda = \lambda_0 + \arctan[\sin c \quad \sin Az \; / \; (\sin\phi_1 \sin c \quad \cos Az)] \qquad \text{-------} \quad (2)$$

Figure 5. shows nodes generated by the methods mentioned above. The nodes in waypoint network spreaded around the basic great circle route so can prune unnecessary waypoints compared with the grid system in dynamic programing method.

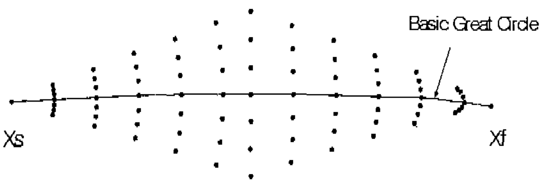

Figure 5. Nodes in Waypoint Network

4.1.2 Arcs Generation

Let n_s as a start point, and $n_i, i \neq s$ as the candidate point for next arrival. The course between n_s and $n_i, i \neq s$ is δ_i, The distance is d_i. The limit of course changing is Θ.

The condition for n_i to be a next arrival point is $d_i \leq D$, $\delta_i < \Theta$. (Figure 6)

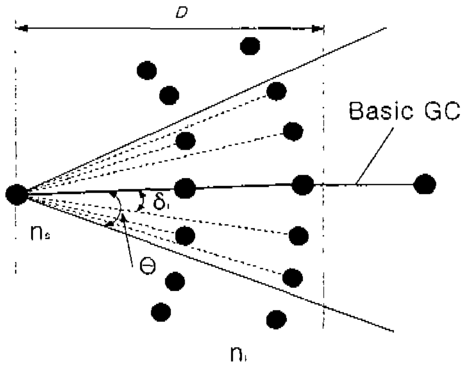

Figure 6. Generation of Arcs

4.2 Solution

4.2.1 Objective Function

The objective function of network model is to minimize sailing time, fuel consumption, and to keep more safe navigation. To produce a practical route, it is important to apply the real aspect of weather condition. but in this network model, only the wave and current is to be considered. That is, only the sailing speed due to weather disturbance and port cost according to arrival time is to be regarded as components of cost estimation. The Objective Function is to

Minimize :

$$J = \sum_{i \in I} T_i + C_P^T, \qquad \text{----} \quad (3)$$

T_i : Sailing time from waypoint $i-1$ to i

C_P^T : Port cost due to arrival time T

where I is a set of all waypoints in selected route. Decision variables in ship routing problem are the controls of course and speed but in the network model, to decrease the size of problem, a speed is suggested to be constant and only the course is taken into account as a decision factor.

4.2.2 Calculation of a Cost

To make a numerical experiment simple, the amount of speed loss is calculated only by the effect of wave and current. The wind effect is ignored because it's relationship with wave is in linear.

1) Estimation of speed loss

The speed loss due to wave is affected by height, direction. Head seas, beam seas and following seas are considered to estimate speed loss. (Figure 7.) Current is considered to be a head current and a stern current. Figure 8. shows the trend of speed loss due to the amount of current. The estimated speed is v' considering speed loss due to wave(v_w) and current(v_c) against a normal speed v is calculated by the formulation :

$$v' = v - (v_w + v_c).$$

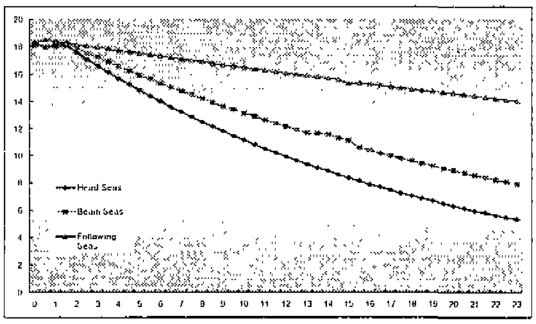

Figure 7. Speed loss due to wave height

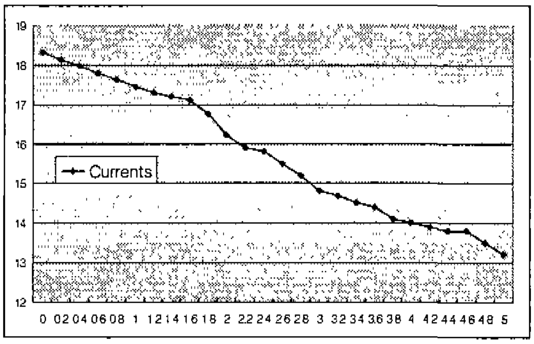

Figure 8. Speed loss due to current

To apply weather effect into speed estimation, the possible sailing region is divided into square cells in discrete manner called a weather cell. The weather cell is a region which has a constant weather condition. Usually, the course line of two waypoints(n_s, n_i) lies on several cells. To calculate voyage cost exactly, it is required to consider the sailing line as a composition of line segments cut by a crossing point($\omega_1, \omega_2, \cdots, \omega_n$) with a cell boundary. The figure 9. shows a schematic diagram of line segmentation.

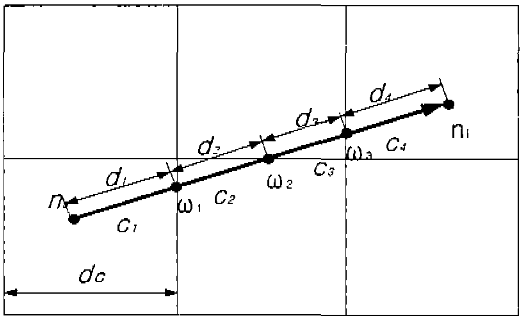

Figure 9. Calculation of cost on multi cell

The sailing time between n_s and n_i is calculated by the formulation

$$T_i = T_s + \sum_{j \in J} \frac{d_j}{v - (\zeta_j + \xi_j)}$$

T_s : a sailing time(cost) form dep. point to waypont n_s

J = a set of crossing points

d_j = distance to ω_j

v : a normal speed without weather disturbance,

ζ_j : the amount of speed loss due to current,

ξ_j : the amount of speed loss due to wave,

Cost function $\frac{d_j}{v - (\zeta_j + \xi_j)}$ means a sailing time. Total sailing time T_f to arrival point n_f is calculated by the formulation $T_f = \sum_{i \in I} T_i$, where I is a set of waypoints on a route. The port cost at the port X_f considering an arrival time T_f is $B(X_f, T_f)$ then total cost is calculated by the formulation :

$$J = \sum_{i \in I} T_i + B(P_f, T_f)$$

2) port cost

The port cost is regarded to be a function for the arrival time.(figure 10) It is assumed that the early and delayed arrival time occurs at the same cost.

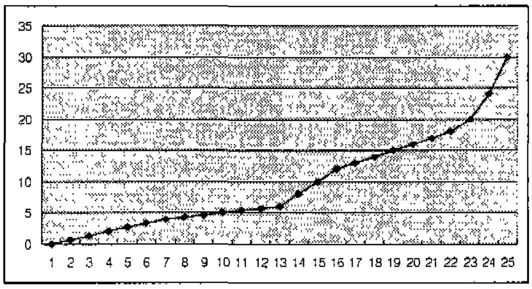

Figure 10. Cost due to arrival time at port

4.2.3 Algorithm

To pick out candidate routes from the waypoint network, a modified depth-first search algorithm is used. The modified depth-first search algorithm is to add one step more into original algorithm and use additional stack structure to store generated candidate routes.

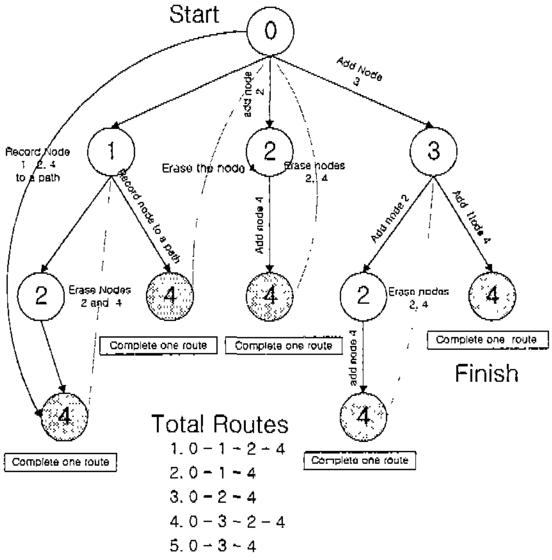

Figure 11. Depth-First Search Algorithm

During the traverse sequence, if the visited node is an arrival point, the path is registered as one candidate route. (Figure 11) The gray node is arrival point and figure 8. shows that 5 candidate routes are generated.

5. Numerical Experiment

5.1 Preparing Network Data

1) Waypoint Network

North-pacific ocean routes are selected to test an effectiveness of a network model. A position of departure point is 35.35 N, 140.56 E, and a position of an arrival point is 33.813 N, 121.18 W. The interval of center point is 120′, the number of center points are 3. An waypoint interval is 600′. (Refer to Appendix 1.) The picture of waypoint network with these data is shown at Figure 12 and waypoints data in detail are shown at Table 5, 6 in appendix 1.

Departure Pt.	35.35 N, 140.56 E
Destination Pt.	33.813 N 121.18 W
Waypoint Interval	600′
Center Point Interval	120′
No. of Center Point	3

Table 1. Data for waypoint network

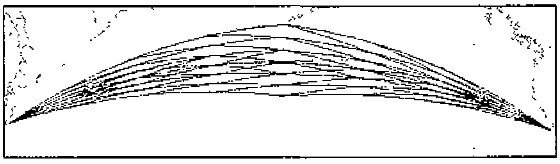

Figure 12. Generated waypoint network

2) Weather Data

A wind and current information are provided in 5 degree unit weather cell. The weather cell boundary is from 15.0 N to 60.0 N. from 120 E to 115 W. For a short voyage, every three hours information is provided and for longer voyage, up to every 24 hour's information is provided. (Figure 13.)

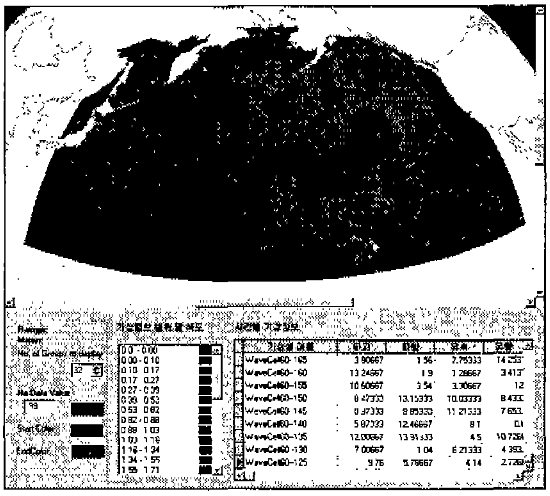

Figure 13. Weather Cells

Table 4. in appendix shows information used in numerical experiment.

5.2 Examination of Result

1) Optimum Route

The optimum route for table 1 is shown on figure 14.. Total voyage cost is 331.162, and port cost is 12.3. So total cost of the route is a summation of voyage and port cost, 343.462. The figure 14. shows that avoiding great circle route under heavy weather is better to save a cost. The waypoints information of distance and average speed are shown at table 2.

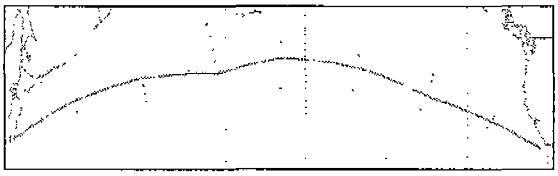

Figure 14. Optimum Ship Route

WP No.	Lat.	Lon.	Co.	Dist.	Avg. Spd.	Voy. Time
1	35 350	140.560				
2	39.716	151.920	64 227	602 468	13.300	45 298
3	41.773	164.891	78.221	604 586	12.500	48.367
4	41.270	178.360	92.845	608.112	14.300	42.525
5	40 191	-169.854	94.977	538 767	16.200	33.257
6	40.810	156.668	88.181	602.904	14.500	41.580
7	40.589	143.092	91.225	620.107	13.200	46.978
8	37.461	130.853	108.146	602.635	15.900	37.902
9	33.813	-121 180	114.802	521.776	14.800	35.255
Voy. Cost				4701 356	14.197	331.162
Port Cost						12.300
TTL. Cost						343.462

Table 2. Waypoint data of Optimum Route

2) Compare to Great Circle route

The effectiveness of network model could be verified by comparing the cost that of great circle route. The information of great circle route is as table 3. The perfect Great circle distance is 4626.92 nautical miles and the summation of a rhumb line distance between each way point is 4640.615 nautical miles. An expected service speed without weather disturbance would be 18 kts, it needs 257.812 hours to sail. (In practice, with currently used navigation equipment, it is impossible to navigate along the perfect great circle route, so 4640.615 nautical miles would be an actual sailing distance.)

The result shows that even though the great circle distance is shorter than optimum route, to sail along the optimum route can save a cost due to weather effect.

WP No.	Lat.	Lon.	Co.	Dist.	Avg. Spd.	Voy. Time
1	35.350	140.560				
2	40.225	151.624	60.947	602.297	12.30	48.967
3	43.899	164.170	68.539	602 488	12.50	48.199
4	46.047	177.996	77.648	602.680	12.40	48.603
5	46.433	-167.536	87.800	602.786	13.20	45.666
6	45.008	-153.339	98.154	602.741	14.50	41.568
7	41.941	-140.204	107.786	602.573	12.60	47.823
8	37.532	-128.515	116.049	602.373	13.50	44.620
9	33.813	-121.180	121.864	422.676	13.90	30.408
Voy. Cost				4640.615	13.041	355.855
Port Cost						14.300
TTL. Cost						370.155

Table 3. Waypoints Data of GC Route

6. Conclusion

In this paper, previous literatures are surveyed and the results are summarized. A ship routing problem is formulated as a network model and it is solved by a modified depth-first search algorithm. Because the author approaches to the ship routing problem as a navigator's point of view, more practical route can be produced than those of previous research. The strong point of a network model is :

1. Isochrone Method and Dynamic programming methods can not produce a perfect Great Circle route even though there exists no interference on the route, but a network model based on great circle navigation methods can produce a perfect great circle route.

2. Isochrone Method produce only one optimum route, but network model can examine several alternative routes

But this paper did not apply the real aspect of cost estimation in weather forecasting, so still further research required to use this model in practical navigation.

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Appendix 1. Virtual Weather Information and Waypoint Network Data

	Weather Cell c_1				Weather Cell c_2			
	Wave		Current		Wave		Current	
time(h)	direction	height (m)	direction	speed (kts)	direction	height (m)	direction	speed (kts)
0	10	14	10	3.5	20	13	10	1.2
3	20	12	15	3.2	30	10	355	1.5
6	30	12	14	2.5	50	8	350	1.8
9	45	5	20	1.2	80	9	335	2.1
12	48	6	21	1.3	100	7	310	2.2
15	40	7	28	1.5	120	8	300	2.6
18	46	7	30	1.8	152	9	270	2.8
21	46	7	25	1.7	180	10	220	2.8
24	38	8	40	2.0	350	11	210	2.8
27	110	8	20	2.3	340	12	210	2.3
30	130	8	10	1.9	320	14	220	2.5
33	120	2	355	2.5	290	16	240	1.9
36	180	2	270	2.6	310	14	159	1.8
39	230	2	280	3.1	320	18	170	1.4
42	230	6	290	3.6	330	19	185	2.1
45	260	6	300	2.1	340	20	200	3.8
48	330	6	320	1.2	355	14	210	3.6

Table 4. Weather Info. of Weather Cell

Dep. Point		Interval 1		Interval 2		Interval 3		Center Point	
		41.655	150.498	46.930	162.393	50.733	176.476	52.493	-169.523
		41.198	150.911	45.951	163.079	49.199	177.126	50.493	-169.584
		40.720	151.287	44.938	163.672	47.634	177.630	48.492	-169.642
35.350	140.560	40.225	151.624	43.899	164.170	46.047	177.996	46.492	-169.698
		39.716	151.920	42.841	164.576	44.451	178.232	44.491	-169.752
		39.196	152.173	41.773	164.891	42.856	178.350	42.491	-169.804
		38.671	152.384	40.703	165.121	41.270	178.360	40.491	-169.854

Table 5. Waypoint From Dep. to Center Point.

Center Point		Interval 1		Interval 2		Interval 3		Arr. Point	
52.493	-169.523	49.865	-154.096	45.443	-140.749	39.712	-129.596		
50.493	-169.584	48.347	-154.540	44.437	-141.169	39.182	-129.732		
48.492	-169.642	46.836	-154.974	43.455	-141.608	38.701	-129.917		
46.492	-169.698	45.331	-155.402	42.491	-142.073	38.261	-130.161	33.813	-121.180
44.491	-169.752	43.827	-155.826	41.538	-142.567	37.851	-130.472		
42.491	-169.804	42.321	-156.248	40.589	-143.092	37.461	-130.853		
40.491	-169.854	40.810	-156.668	39.637	-143.649	37.078	-131.308		

Table 6. Waypoint From Center Point to Arr.

船舶管理信息系统

中远集运　许军　徐波

摘要　本文通过对船舶管理公司的职能分析，探讨如何应用现代信息化管理手段，构筑船舶信息传递、处理的平台，解决现行船舶管理中由于信息传递不通畅而造成的一系列问题，通过建立各种资源库，运用多种信息交流方式，实现船舶管理过程的资源共享与智能化，保证船舶的安全运营。

关键词：　船舶管理　信息系统

1. 概述

航运业是资本、技术密集型的国际化产业。但在这个古老而又传统的行业中，做为航运基础的船舶管理，由于受到稳健传统的管理文化影响，信息技术在船舶管理中的应用始终落后于其他行业。为解决现行船舶管理中由于信息传递不通畅而造成的一系列问题，必须建立一个满足船舶管理公司需要的计算机管理信息系统，构筑船岸之间各种数据、信息及时传送、处理的桥梁和平台。与此同时，伴随着管理平台的建设，逐步形成一种新型的管理模式，从而根治现行船舶管理工作中的弊病。

1.1 我国船舶管理模式的弊端

中远集运是中远集团旗下的集装箱专业运输公司，集装箱运能位于世界前列。中远集运船舶管理公司按技术职能进行专业化分散管理，其主要管理职能包括：修船管理、证书管理、物资管理、费用管理、设备管理等。由于专业分工过细，现行的船舶管理模式在实际操作中，时常出现一项工作的多层次、多头管理；各业务部门间缺乏联系和沟通，信息的共享性差、传递速度慢，管理效率难以提高。例如修船管理：确定修理日期与修理工程时，必须掌握船舶证书换证时间与船舶班期情况与修船厂家的信息，维修费用的额度、备件的订购与库存情况，而所有这些管理工作，都要靠人工协调来完成，工作效率难以满足现代化航运企业的要求，整个操作过程难以监控。

1.2 建立信息系统平台的意义

建立船舶管理公司的信息平台，其意义主要在于：通过提高船舶管理过程中的信息交换速度、实现船舶管理的过程控制，有效降低人为失误的可能性、加强各环节工作的协调性；通过建立各种类型的资源库、扩大信息交流面，提高各种管理活动间信息资源的共享度和利用率，为建立公司知识库、实现船舶管理智能化、扩大船舶安全保障面，从而提高市场竞争力奠定基础；最终达到以下目标：满足国际公约与国家法规对船舶管理的要求；满足国际航运市场对船舶管理的要求；满足信息化社会环境对船舶管理的要求；满足船舶新技术、新设备对船舶管理的要求。

2. 信息系统平台的设计

2.1 信息系统平台的构成

船舶管理的基本对象是船。船舶的航行安全度、营运经济性，设备完好率等主要信息，是船、岸管理人员必需进行控制的。因此，船舶管理信息系统平台的建立，必须以船、岸间管理信息与资源的共享为基础。

船舶管理公司信息系统平台的构成，如图 1 所示。

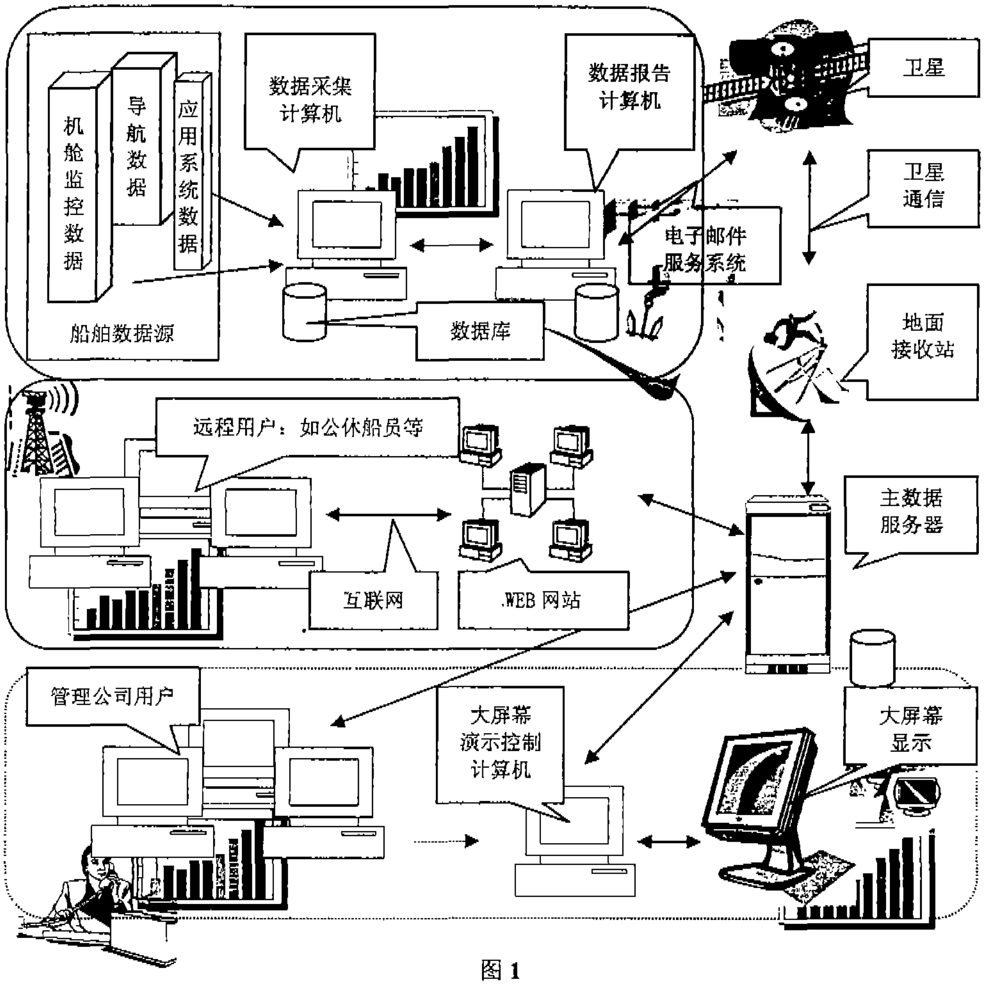

图 1

2.2 船岸信息的交换方式

随着计算机技术和应用的普及，企业的管理需求也在不断提高，传统的船岸通信方式已不能满足现今的船舶管理需要，采用数字通信已成为必然。世界上已有很多成熟的数据化通信系统，部分产品还具有主叫的功能，亦即实现岸基呼叫船舶、读取船舶数据。但是考虑到高昂的卫星通信成本，正常情况下，建议每次正常通讯时把数据文件附带传送到岸站，以便随时查看，只有当必要时，才使用由岸站完成主动呼叫、按需调用船舶的信息、数据的通信方式，通过 SHIP DATA TERMINAL，借助专业应用软件，就可以了解船舶航行状态、设备工况参数和船舶管理信息。

2.3 信息采集与传送处理

原始信息、数据的采集功能。数据采集计算机负责对各种船舶数据源按设定时间进行周期采集和自动存储后，通过定时数据备份，按设定时间周期性地向数据报告计算机输送数据。这些船舶数据源包括：导航数据、机舱监控数据以及应用系统数据等。采集系统的前台程序可以设计成定时自动的采集方式，比如，对于机舱监控数据，数据采集计算机（按程序设定）每 20 秒钟循环检查各警报点参数（各警报点编号、上下限值、测量值、报警值等）一次。在循环检查周期内如果监测到某个警报点超过上下限值，则自动添加该点的报警记录、报警复位后再次自动记录警报消除记录。

数据报告、调用功能。由数据报告计算机负责存储、处理从采集计算机送来的数据，并按需定期向数据通信系统发送最新数据、信息，当下次船、岸通信时，对公司岸基数据库进行数据信息的报告与自动更新；当需要时，岸基可直接向船舶发出数据调用要求、从数据报告计算机按需调用数据，达到实时监控的目的。

船岸间数据交换功能。数据报告计算机上安装有专用船岸通信系统，负责船舶和公司之间数据、信息的双向交换。所有数据传送过程都备有实时监测功能，成功与否，都会向前级计算机发送回应，以检查数据是否成功导入到相应数据库内，确保数据传送的正确性。

2.4 信息系统平台用户端

在公司岸基设置的用户终端，可以按需显示船位、航向、航速、下一目的港、预计到港日期以及动力装置、设备的运行工况等相关参数信息。显示内容可预先设定，以便船舶管理人员能随时得到各种数据与信息。

用户端的工作界面，如图 2 所示。

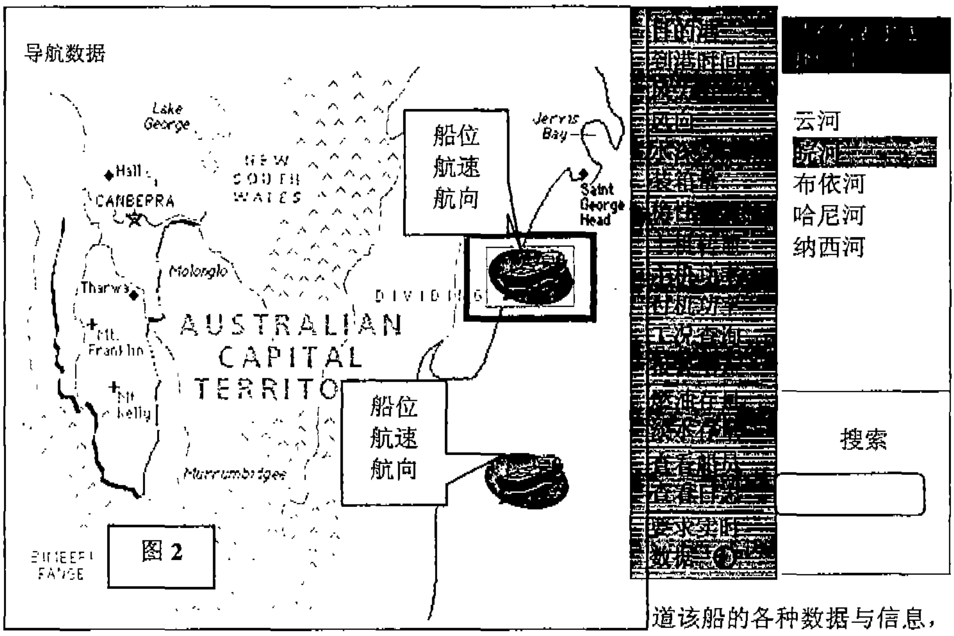

图 2

道该船的各种数据与信息，而且随时可以要求得到船舶实时动态数据。如果想了解更多，只需要在菜单栏点击相应的功能钮即可实现。

3. 系统的管理职能结构

船舶管理公司的信息系统平台一般可划分为二级：公司级管理平台、船舶级操作平台。两者间的信息交换通过专用通讯系统进行，而两个平台的管理要素是基本相同的，从集合论角度看，船舶级平台是公司级平台的一个子集。船舶管理公司信息系统所包括的主要业务职能，如图 3 所示。

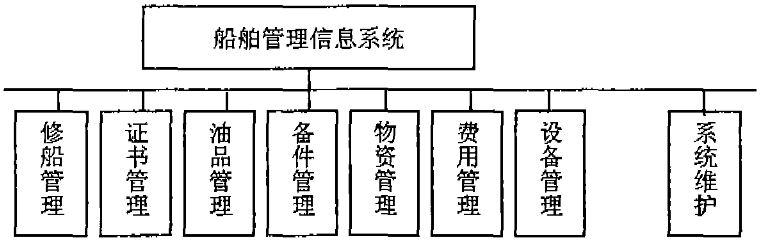

图 3. 船舶管理信息系统管理要素框图

4.信息系统的引进与开发

总的来讲，信息处理系统，必须依靠采集系统提供的完整数据，实现管理全过程的高度自动化，尽可能多地为管理人员提供详尽的信息、数据，随时可以进行界面友好的人机交流和岸船监督。一个好的管理信息系统，不但是管理人员工作上的好帮手，而且能促进管理人员之间的交流。目前世界上有很多比较成熟的船舶管理应用系统，例如挪威的 Amos 等，比较适应我国船舶管理特点的有中远集运自主开发的STMS。

船舶管理公司在构筑船舶管理信息系统平台时，应该在引进、学习国外成熟应用系统的现代化管理经验和信息技术手段的基础上，立足于自主开发。闭关自守必然落伍，全盘引进则易受制于人。中远集运目前已经实现船岸通信自动化，船岸之间的信息交流已较前便捷许多，只要稍做深度开发，就可以实现岸到船的“准实时”数据调用、船和船之间的低成本信息交流，这样，加强了船岸之间的信息交流，扩大了船舶管理公司对船舶的监督力度，为船舶航行安全提供了技术保障。

5. 结束语

船舶管理是船东公司经营中的重要环节，与公司的竞争能力密切相关。我国航运企业虽然历经几代人的努力，积累了丰富的管理经验，形成了一套行之有效、有自己特色的船舶管理机制，然而传统的计划管理模式长期采用的是分散管理模式，即将管理业务按职能划分成不同科室，来分管技术、备件等专业性工作，其管理模式和管理水平与经济发达国家相比还有差距，与市场经济下先进的企业管理制度相冲突，管理体制不适应现代管理技术手段，这就在船舶管理信息系统开发的过程中形成了障碍，严重制约了企业的竞争能力。尤其是我国加入 WTO 后，面对国际航运市场更加激烈的竞争，研制开发与我国船舶管理体制相适应的信息系统平台已迫在眉睫。所以船舶管理信息系统平台的开发具有现实意义，它将直接提高船舶技术管理的信息化、现代化水平，进而提高船舶管理公司的可持续发展能力；它作为先进管理技术应用于船舶管理，即将引起管理模式的变革，是现代船舶管理发展的必然趋势。