Information System for Ship Management

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Abstract: Based on the analysis of the functions of ship management company, this paper aims to explore how to build the platform to transmit and process the information about ships by means of modern information management so as to solve a series of problems caused by blockages in information transmitting in present ship's management. The paper also talks about the necessity of establishing various resource bases and using different information communicating methods to realize the resource sharing and intellectualization of ship's business.

Key words: Ship management Information system

1. Introduction

Shipping is an old, traditional and international industry characterized by capital and technology intensiveness. But its foundation, ship management, influenced by the steady and traditional management philosophy, is always lagging behind other industries in using the information technology. To solve a series of problems caused by blockages of information transmitting in present ship management, a computer management information system must be set up to satisfy the needs of ship management company and a bridge and platform must be built to collect, transmit and process various data and information between ship and shore. Meanwhile, the establishment of management platform will bring about a new model of management so as to eradicate the problems in existing ship management.

1.1 Problems of present ship management model in China

COSCO Container Lines is a specialized one with its business ranking high in the world. Its ship management company distributes the management separately to different departments, i.e. decentralized management, and the major management functions include: repairing management, certificate management, material management, expenses management, equipment management, etc. Such a narrow distinction often results in the multi-level or multi-head handling with one particular work. The lack of communication between different departments causes a low quality of information sharing, slows transmitting and also makes the managing efficiency difficult to be raised. Take the ship repairing as an example, to decide the date and progress of the repair must be based on the following: expiry of the certificate, transportation schedule, and information of the repair factory, repair expenses, order and storage of parts, all these have to be finished through the coordination among people themselves. Therefore, the working efficiency cannot meet the requirement of modern shipping company and to supervise and control the whole process is quite difficult.

1.2 Significance of building the information system platform

The information system platform will speed up information exchange in ship management, and realize the whole process control of the management so as to reduce the possible man-made errors and to enhance the coordination among different departments. The establishment of various resource bases can broaden the scope of information exchange, raise the rate of information sharing and utilizing in all managerial activities, thus providing a basis on which to building a company knowledge base, to intellectualize the ship management and strengthen the assurance of ship's security, and to improve its competitive power in the market. The information system platform has its final aims to satisfy the demands upon ship management raised by the international convention, internal laws and regulations, by the international shipping market, by the informationized social environment and by the new shipping technologies and equipment.

2. Design of information system platform

2.1 Constituents of information system platform

The target of ship management is a ship. What the management staff in ship and on shore must control are such major information as shipping security, transportation profit and well-equippedness. Therefore, the establishment of the information system platform for ship management must be based on the information and resource sharing between the ship and shore.

Figure 1 shows the make up of the information system platform.

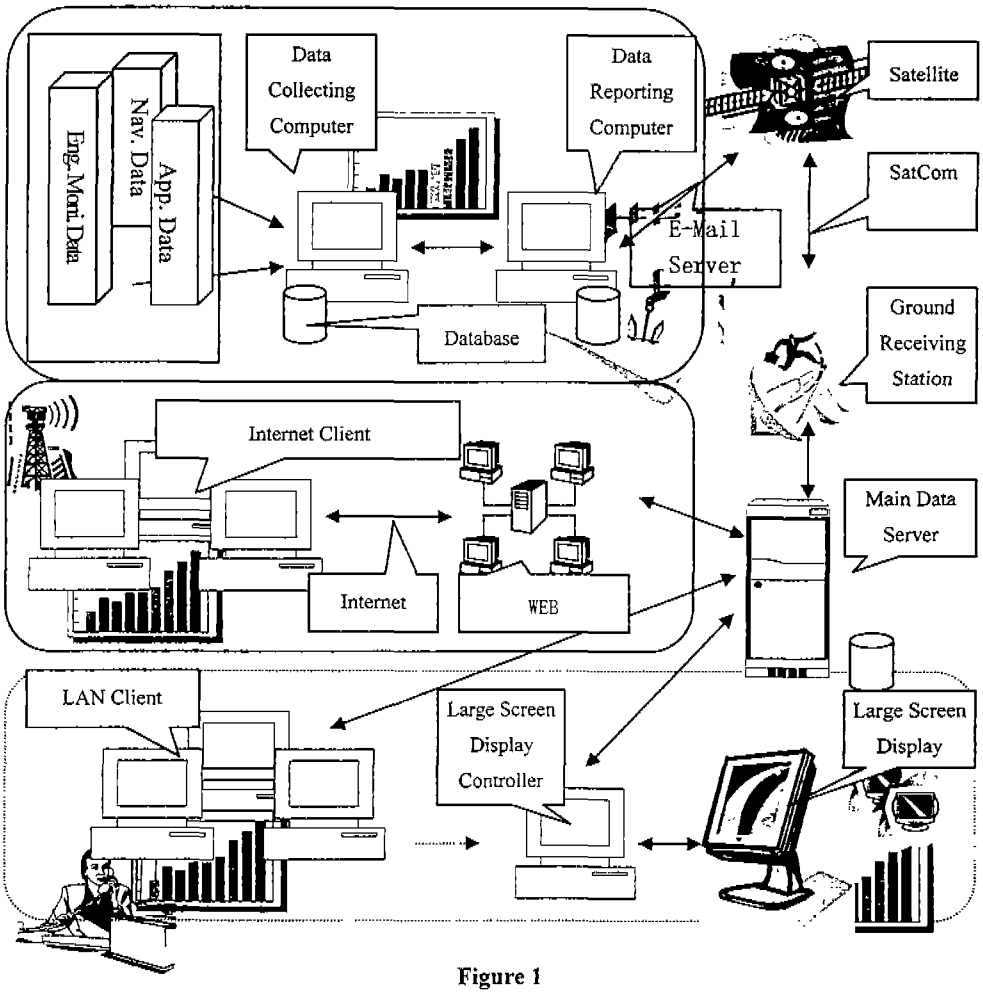


Figure 1

2.2 The way of information exchange between ship and shore

With the popularization of computer technology and application and the increasing demand upon business management, the traditional ship-shore communication model can no longer satisfy the needs of today's ship management and the application of digital communication becomes a must. The world has boasted many mature systems of digital communication with some products having the function of dialing that is to call ships and read the data of ships on the shore. However, take the expenses SATCOM into account, it is suggested that in every normal communication, the file of data can be attached and transmitted to port of destination for check at any time, and only when necessary, the port of destination needs to dial and transfer the required information and data communicating model of the ship for use so as to see the shipping situation, the parameter of working equipments and information about ship management by means of ship data terminal and professional software.

2.3 Information collecting and transmitting

The function of collecting original information and data. The data-collecting computer is responsible for gathering and storing automatically various ship's data source, and for transmitting periodically the data to data-reporting computer in the setting time by making timing data copies. The ship's data source consists of navigation data, cabin monitoring data, application system data, and so on. The front bench program of collecting system can be designed into a process of timing and automatic collecting. To cite cabin monitoring data as an example, the data collecting computer (programmed) checks every 20 seconds parameters in each alarm point (number of each alarm point, range, measured

value, alarming value, etc) In one circle of periodic check, if the computer detects an alarming point is out of the range, the alarming record will be added automatically and again alarming removing record will act on itself after the alarm point retires to its position.

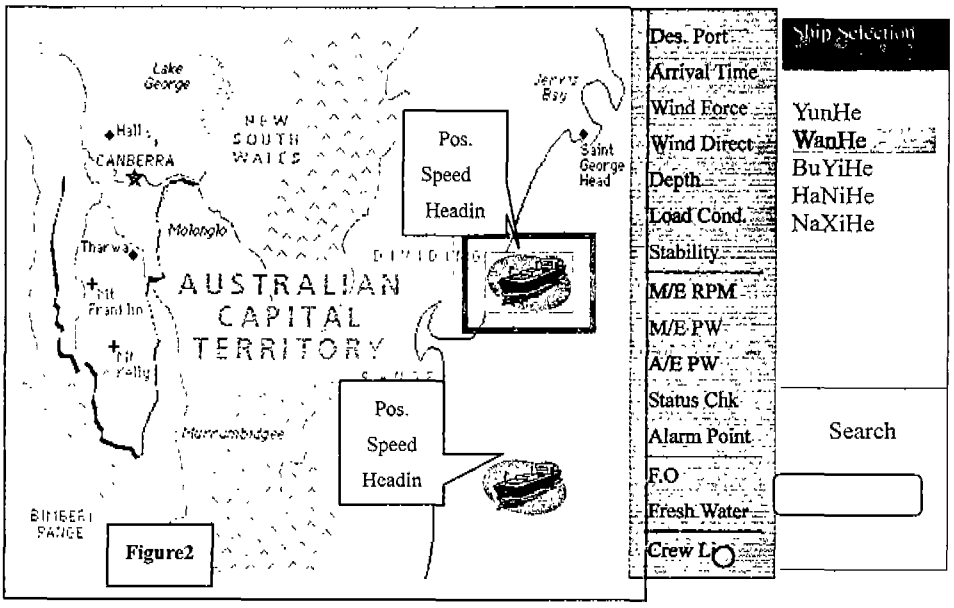
The function of data reporting and calling. Data-reporting computers are responsible for storing and processing the data from collecting computers, and sending the newest data and information to data communication system as required to the effect that the data information can be reported to the company's shore database and can renew itself when the ship communicates with the shore next time. If necessary, the shore can send out direct orders to ships to transfer required data from the data-reporting computer, and so the aim of real-time monitoring is achieved.

The function of data exchange between the ship and shore. A special ship-shore communication system is fixed in data-reporting computers, responsible for the exchange of data and information between ships and companies. All the data are sent in the real-time monitoring system, and whether the transmission is successful or not, a response is sent back to the previous computer to see whether the data has been transmitted to the corresponding database correctly.

2.4 User side in information system platform

At the user side of company can be as required shown such information parameter as ship's position, direction and speed of navigation, port of destination, expected date of arrival and power installation and working condition of equipment. The contents can be preset to provide at any time the data and information for the ship's management staff.

Figure 2 is the interface of the user side.



On choosing the ship in the right column of the ship list, the company's management will be able to know various data and information about the ship, and can get the real-time, dynamic data of the ship. To click corresponding functional key on the menu produces more information.

3. The structure of the system management function

The information system platform of ship Management Company can be divided into two levels: company's management platform and ship's operating platform, both of which use a specialized communication system to exchange information. Fundamentally speaking, the two platforms have the same management factor, and ship's platform is one subset of company's platform from the angle of the set theory. Information system of ship's management company includes the following major business functions, as shown in Figure 3.

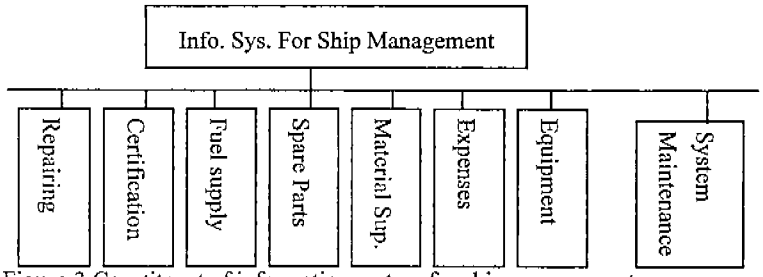


Figure 3 Constituent of information system for ship management

4. Introduction and development of the information system

Generally speaking, the information processing system should rely on the full set of data provided by the collecting system, realize the automation in the whole managing process, and provide management staff with detailed information and data as much as possible so that friendly person-computer communication and shore-ship supervision can be effected. A good management system can serve as a helping hand for a management clerk, but can promote the communications among the management staff as well. So far many quite mature ship management application systems have emerged, e.g. Amos in Norway and COSCO Container Lines developed STMS independently which is suitable for China's ship management.

While building information system platform for ship management, the ship management company should develop on its own after introducing other's modern management experience and employing information techniques of the mature application system abroad. Closing the door will make us lag behind while all-sided absorption from abroad will make us easy to be controlled. At present, COSCO Container Lines has realized the automation and the ship-shore communication becomes much more convenient. A further development will bring about the quasi-real time transfer of data between ship and shore and low priced information exchange between ships as well. Therefore, the effective information exchange enables ship Management Company to strengthen the supervision on ships and provides sufficient techniques to ensure the security of ships in navigation.

5. Conclusion.

As an important link in running a shipping company, ship management is closely related to the competitive power of the company. As for shipping companies in China, the efforts of several generations have produced a rich experience in management, as well as an effective ship management system with its own features. However, the traditional planned management has for a long time employed a decentralized management model, that is, different departments were established to effect their functions separately to deal with techniques, copies, etc. This management model and its management level are inferior to those of developed countries, and conflict with the market economy. The inadaptability of the management model to modern management techniques causes obstacles in developing ship management information system and curbs the improvement of business competitiveness. What is more, after China's entry into WTO when facing sharper competitions in international shipping market, it is imperative to research and develop information system platform suitable to China's ship management system. Therefore, it is of significance to develop information system platform of ship management, which will make ship's technology management more informationized and modernized, thus improving the sustainable development of ship management company. As an advanced managing technique, the development of information system platform will result in a revolution in management models and represent a kind of inevitability in the development of modern ship management.

智能避碰系统中船舶行动局面的划分

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摘要：基于对船员避碰行为的大量调查、海上避碰实际和对会遇两船避碰行动不确定性所进行的研究，为了避免或减少会遇两船的不协调避碰行动，在国际海上避碰规则规定的不同会遇局面的基础上，提出了会遇船舶行动局面的概念，并对不同行动局面下各船的转向避碰行动方向作了说明。所得到的结果在智能避碰系统中，建立了一种避免或减少会遇船舶采取不协调避碰行动机制，对于智能避碰系统的研究具有一定的实际意义。

关键词：智能避碰系统；船舶；行动局面

1　引言

避碰规则对能见度良好时三种会遇局面的划分，是为了确定在特定会遇局面下，两船在避碰中的权利和义务。在交叉相遇和追越局面中，一船负有让路义务，而另一船则负有保向与保速义务。然而同样是交叉相遇局面，当直航船位于让路船的相对方位不同时，让路船采取的避碰行动并不完全相同。在某些情况下采取向右转向，而在另外一些情况下采取向左转向的避碰行动。另外，根据避碰理论，当直航船位于让路船的相对方位大于一定值时，左转比右转更有利于避碰，对让路船造成的偏航损失也相对较小。因此，除避碰规则规定的会遇局面划分外，还有让路船避碰行动局面的划分问题。

在船舶智能避碰系统中，研究船舶避碰行动局面划分问题，第一，是由于在世界范围内还没有关于避碰行动局面划分的标准，同时国际海上避碰规则对会遇局面的划分太过笼统，而所建立的智能避碰系统，若完全依据规则的划分，将不适应目前海上避碰的实际情况，也可能产生新的危险；第二，是把船舶避碰过程程式化，并作为知识库的一部分；第三，是为了将让路船的最可能行动融入智能避碰决策系统，以便于将有该系统的直航船在必要时采取有利于避免不协调的避碰行动。

2　船舶行动局面的概念其及划分

2.1 船舶行动局面的概念

船舶行动局面是指以国际海上避碰规则规定的船舶会遇局面、船员海上避碰实际做法为基础，考虑会遇两船速度比、让路船采取避碰行动（改变航向）所产生的偏航损失大小等情况下，所确定的采取左转或右转的，让路船与直航船之间的会遇局面。

2.2 划分说明

当能见度良好时，船舶避碰行动局面基本上是依据规则对会遇局面的三种划分进行的。根据避碰规则规定，避碰行动局面按图 1 划分。

互见中两船会遇，将避碰行动局面划分为 A、B、C、D、E、F 六种。其中对位于 A 区域的一船，该船为直航船，另一船为让路船并应采取向右转向的避碰行动；对一艘船位于 E 区域，该船为让路，另一船为直航船，通常直航船不采取任何避碰行动，只有在让路船与直航船形成紧迫局面时仍无采取任何避碰行动，直航船才采取向右转向的避碰行动；对位于 C、D 区域的一船，该船为追越船，另一船为被追越船，通常被追越船应保向与保速，只有当追越船与被追越船形成紧迫局面时，根据追越船在 C、D 的相应区域及初始 DCPA 情况，被追越船才采取相应的避碰行动；对于 B 区域的一船，该船为直航船，另一船为让路船，由于直航船位于让路船的舷角较大，而且有时采取较大幅度右转向避碰行动的效果，不如左转避碰行动的效果明显。因此，根据两船速度比及采取左转向或右向所引起的航向偏差损失大小确定采取左转或右转向。

关于 C 与 D 分界线的确定：通过对 236 张调查问卷的统计分析，当本船追越他船且位于他船舷角 210° 且 $DCPA=0$ 时，向左和向右转向的比例几乎各占 50%。因此，C 与 D 区域以 210° 作为分界线。

那么，当存在碰撞危险时，对位于 C、D 区域并与一船构成追越局面的追越船，当其不采取避碰行动且形成紧迫局面时，被追越船应采取什么样的转向避碰行动呢？或者，当一船位于 C、D 区域且追越另一船时，追越船又该如何行动呢？避碰知识库中必须包括该方面的知识。

通过对回收的 236 张调查问卷统计分析，当本船追越他船时，有 89.75% 的驾驶员是根据初始 DCPA 值及本船是位于 C 或 D 区域确定的。若本船位于 D 区域且 $DCPA \le 0$ 或本船航向平行于被追越船时，采取向左转向避碰行动；若位于 D 区域且 $DCPA > 0$ 时，采取向右转向避碰行动；若位于 C 区域且 $DCPA \ge 0$ 或两船航向平行时，向右转向；若位于 C 区域且 $DCPA < 0$，则向左转向。

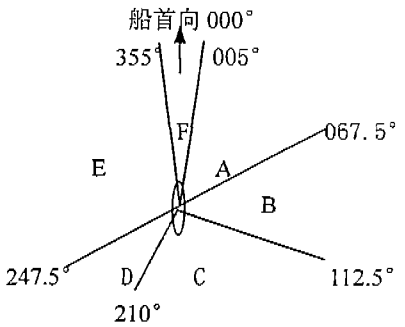

图 1 两船互见中避碰行动局面划分图

因此，若本船被位于 C、D 区域的他船追越，当他船不采取避碰行动时，在预测他船最可能采取避碰行动前提下，采取被大多数船员认为是协调的避碰行动。

关于行动局面（或称会遇类型、基本会遇局面），在不同的研究中有不同的划分。参考文献[1]将基本行动局面划分为六个类型，即：（1）他船从左舷向右舷穿越；（2）他船从

右舷向左舷穿越；（3）他船追越本船；（4）本船追越他船；（5）他船正对本船而来；（6）他船处在停车状态。其划分方法基本是根据国际海上避碰规则的规定进行的，只是增加了本船与停车他船会遇一种情况。这种划分对会遇两船在正常情况下的避碰行动是适当的，但当本船为直航船，他船又未及时采取避碰行动，以致形成了紧迫局面时，对本船应如何采取避碰行动涉及的较少。

参考文献[2]将基本会遇局面分为六种。在其划分中，除追越局面外，其它会遇局面基本与海上避碰规则的规定相同。将追越局面划分为左、右两种追越，在一定程度上是为了确定本船所采取的避碰行动是左让还是右让。

在此指出：不管参考文献[1]对基本行动局面的划分，还是参考文献[2]对基本会遇局面的划分，主要是为了确定两船会遇时，本船的避碰行动方法。

本文对避碰行动局面的划分有三个目的：其一，遵守海上避碰规则的规定；其二，在他船未按国际海上避碰规则采取行动时，为避碰知识库提供本船采取紧急避碰行动的知识；其三，总结归纳船员在海上避碰行动的实践经验。

对追越局面一分为二，主要目的是为了：第一，当他船追越本船且未在适当距离上未采取避碰行动时，本船在预测他船行动的基础上，采取有利于避免两船不协调的避碰行动。对 C 区域的追越船，当 $DCPA \geq 0$ 时，包括了两种情况：一种是他船位于本船舷角 112.5°～180° 范围内，且过本船船首，预测他船最可能采取右转向行动；另一种是他船位于本船舷角 180°～210° 范围内，且过本船船尾，则预测他船最可能采取右转向行动。因此，当他船未在适当距离上采取避碰行动且形成紧迫局面时，本船采取向左转向行动；对 C 区域的追越船，当 $DCPA < 0$ 时，也包括了两种情况：一种是他船位于本船舷角 112.5°～180° 范围内，且过本船船尾，预测他船最可能采取左转向的避碰行动；另一种是他船位于本船舷角 180°～210° 范围内，且过本船船首，则预测他船最可能采取右转向的避碰行动。因此，在这种会遇态势下，若他船未采取行动且形成紧迫局面时，本船采取右转向行动。而对 D 区域的追越船，当 $DCPA \leq 0$ 时，他船过本船船首，则预测他船最可能采取左转向的避碰行动；当形成紧迫局面时，本船采取右转向行动；当 $DCPA > 0$ 时，他船过本船船尾，预测他船最可能采取右转向行动，当他船未采取避碰行动且形成紧迫局面时，本船向左转向。第二，是为了确定本船应采取的避碰行动。当本船在相应区域追越他船时，根据如他船在相对区域追越本船所预测的他船行动一样采取相应的避碰行动。

本文对避碰行动局面划分的优点表现为：根据两船的依据规则，不同会遇态势，船员海上避碰实际，并将其综合后融入智能避碰决策系统，在智能避碰系统中引入了一种避免或减少避碰行动不协调的制；在追越局面中，本文的划分方法符合船员的一般做法，尽量吸收了当前关于船舶避碰行动局面划分的研究成果。

3 能见度不良时行动局面的划分

在能见度不良时，船舶避碰操纵在一定程度上，受能见度良好时两船基本会遇局面的影响。因此，在对能见度不良情况下的避碰行动局面进行划分时，必须对这种影响进行考虑。

3.1 国际海上避碰规则对能见良不时船舶避碰行动的要求

根据国际海上避碰规则的要求，当能见度不良时，除按规则鸣放雾号、采用安全航速、保持正规了望、机动船舶备机航行等要求外，对船舶避碰操纵的要求主要有以下几方面的要求：

（1） 当存在碰撞危险时，应及早采取避碰行动，且应尽可能避免：

- 除对被追越船外，对正横前的船舶采取向左转向；
- 对正横或正横以后的船舶采取朝着她转向。

（2）除已断定不存在碰撞危险外，每一船舶当听到他船的雾号显似在本船正横以前，或者与正横以前的他船不能避免紧迫局面时，应将航速减速到维持其航向的最小速度。必要时，应把船完全停住，而且，无论如何，应极其谨慎地驾驶，直到碰撞危险过去为止。

3.2 能见度不良时行动局面的划分

当前用于船舶避碰操纵的图表较多，为使划分具有一定的权威性，对于船舶避碰行动局面划分，参考了 1970 年英国航海学会工作组所提出的船舶操纵图进行划分。该操纵图只限于航向改变，但关于航速改变的意见也载于工作组编写的附加说明中。该图主要是为仅凭雷达观测到一船，而未看见时进行转向避碰操纵时所使用的。

首先，根据每个危险目标与本船的会遇态势划分为左让或右让目标，如图 2 所示。按目标相对方位划分为 A、B、C、D 类。其中，D 类为右让目标；C 类为左让目标；A 类中除本船追越目标船且位于目标船相对方位[210°,292.5°]时，本船采取左转避让外，对其它被追越目标及在该方位的来船，一律采取向左转向的避碰行动；B 类中的危险目标定义为左让目标。

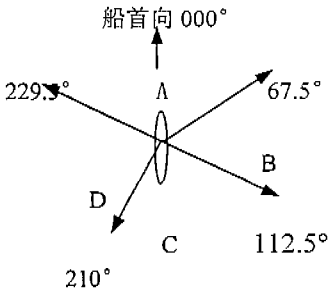

图 2 能见度不良时两船会遇避碰操纵划分图

这种划分的根据是：第一，它既完全符合 1970 年英国航海学会工作组所提出的船舶操纵图的划分，又同时吸收了其它避碰操纵图的优点，从而更适用于在能见度不良情况下的避碰操纵；第二，划分 A 区域除满足规则十九条的规定以外，还考虑到位于本船右舷舷角 067.5° 以内来船可能的行动及本船采取避碰行动的效果；划分 B 区域，显然满足规则第十九条对正横的船舶避免采取朝着它转向的规定，同时也与能见度良好时的避碰操纵相一致，这可简化建立避碰知识库工作，同时也考虑了本船采取转向避碰行动的效果；划分 C 区域，也满足了规则第十九条的规定，即对正横后的船舶避碰采取朝着它转向的要求，也充分预测了追越船最可能采取的避碰行动，有效地避免了可能产生的不协调避碰行动；划分 D 区域，一方面充分考虑了 D 区域来船最可能采取的避碰行动，另一方面也完全符合规则第十九条的规定。

综上所述，可以看到上述对能见度不良时两船会遇局面的划分是合理的、符合国际

海上避碰规则中关于能见度不良时船舶行动规则的要求。

4 结论

为防止两船碰撞，制订相应的规则是十分重要的。然而，当海上的避碰情况变化时，相应的规则也应该随之变化。在船舶避碰中一个很重要的基础是减少在避碰中船舶行为的不确定性，制定的避碰规则、防止船舶碰撞设备的应用等在一定程度上都体现了这一目的。本文根据避碰规则及海上避碰实际：

（1）提出了船舶行动局面的概念，以完善智能避碰系统中的船舶会遇局面；

（2）划分了船舶会遇局面，在智能避碰系统中建立了一种避免或减少不协调避碰行动的机制。

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