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論 文

The Marine Safety Judgment Management System for Scientific Investigation and Analysis of Marine Accidents

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해양사고의 과학적인 수사 및 분석을 위한 해양안전심판관리 시스템

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ABSTRACT : *In the marine accidents judgment, investigation of truth of matters is one of important process to find out the reason of ship collision accidents. In this paper, reproduce system of ship collision accidents using ship manoeuvirng simulator technique will be introduced with which marine accidents can be easily reproduced in visual display at the case of marine accidents trial. In this system if the users select the type of ship and location of accidents, the process of ship collision will be provided in 2D and 3D display. The system also provides environmental visualizationdisplay such as fog whether and day-night view including various view angle that can be helpful to find out the reason of accidents.*

KEY WORDS : Ship Handling Simulator, Marine Accidents, Ship's Collision

요 약 : 해양사고에 있어서 사고조사는 선박충돌사고 원인을 알아내는 중요한 절차 중에 하나이다. 본 논문에서는 선박조종 시뮬레이터 기술을 이용한 선박충돌사고 재현 시스템이 해양사고가 해양안전심판정에서 쉽게 시각적으로 표현되는 것을 서문으로 붙인다. 이 시스템에서는 사용자가 선박의 종류와 사고의 위치를 선택하게 되면 선박 충돌 진행 상황이 2D 와 3D Visual 화면으로 제공된다. 이 시스템은 또한 사고의 원인을 알아내는데 유용하게 이용되는 다양한 View Point를 포함하여 안개상황 혹은 주야간 등 시각적인 환경도 제공된다.

핵심용어 : 선박조종시뮬레이터, 해양사고, 선박충돌사고

1. Intorductions

Until now marine accidents judgment was generally carried out based on documentary evidence and oral statements in Korean maritime safety tribunal. Therefore the intelligent technology level in the judge process was not so enough such that the public or related person could not easily access the inquiry process and evidence material or documents. The requirement for marine safety judgment system utilizing computer and other intelligent system has been increased in Korea. In other hands, ship manoeuvring studies have been carried out by many researchers [1]. These studies have been applied to other fields such as ship design sector and marine training course for mariners.[2-3]

The reproducing system for ship collision accidents is gaining increasing attention due to the trend of these studies. Until now, the marine safety tribunal has been carrying out an inquiry upon request of the investigator, designated person interested in the marine accident or inquiry counsel or officer. The marine accidents have

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been investigated by questions and answers of the persons involved in the accidents. Based on answers of the persons interested in marine accident, the accident situations are plotted on Sea Chart so as to track the causes of marine accidents. These judgment process may cause investigators make some errors.

In this research, the reproduce simulator system for marine accidents is proposed.The visual situation between ships and environmental circumstances are provided in the proposed system. The users are provided with many visual and animated data relating to the ship accidents. The purpose of the system is to improve the efficiency of marine safety judgment system.

2. SYSTEM STRUCTURE

The marine accidents reproduce system consists of two computers and one public screen equipment as shown in Fig. 1.

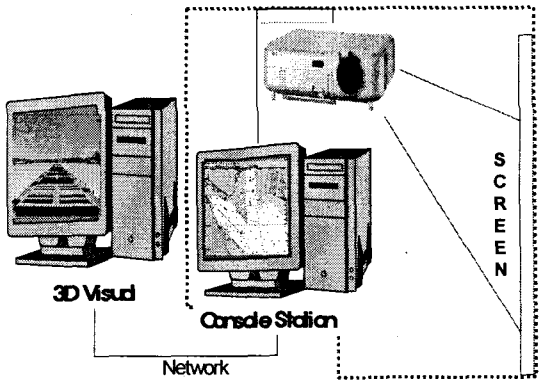

Fig.1. System Structure.

Table. 1 Ship Model List

ShipName	Type	LBP	Breadth
Con - 8100	Container	319	42.8
Lng - 145000 m3	LNG	270	43.4
Tanker - 299000DWT	Tanker	322	59.6
BulkC02L	Bulk-1	193.1	20.73
BulkC240M	Bulk-2	234	32.2
CarC200M	Car carrier	198	32.25
COAST58M	ship	55	9
CRUIS10K	Passenger ship	260.7	31.5
FISH02L	Fish boat	30	6
PRODC03L	Product Carrier	141.5	23

2.1 Console module

Console computer module is the core part in the marine accidents reproduce system. The console provides main menu that select the accidents location, environmental circumstance and the model of ships involved in the accidents. Therefore the situation of ship collision accidents can be realized on the display visually. The day-night time mode and fog weather option are also provided in environmental menu. When user selects the area of ship accidents, the 2D-digital map is displayed in console computer. Ship's location data of collision accidents can be input into console computer in latitude and longitude coordinates. The trajectories of ship are plotted in 2D visual view then the situation of ship accidents are reproduced. Also, the option menu is provided to select ship's model type and size. Table 1 shows the list of ship's model and type programmed in the system. The ship collision accidents, especially when they are large-scale ships, can impact on the marine environment for example, oil pollution, however the majority of accidents are caused by small ships like fishing boats. So it is important to build up various types of ships as many as possible. Further works will be carried out for more sufficient ship model.

In addition to basic function in main menu, various control options are available. Normal and fast display mode function are provided to adjust the reproduce speed. Visual point can be easily changed from 1st person to 2nd and 3rd person's view point to supply various view angle in the system.

2.2 3D Display Module

The role of 3D-display module in Fig. 1 are as follows; 3D model of ship and layout of seaside are stored. Graphic tool such as 3D module creator and display engine are used to provide the users with realistic vision in 3D display.

In existing marine accidents judgment, judge and investigator have been investigating the reasons of marine accidents based on oral statements and documentary materials submitted by the persons concerned. Small wooden ship model are used to explain the situation of collision and inquiries are made to find out the truth of mattersabout accidents. However there have been some difficulties of explaining the accidents in detail in the way of the existing judgment process. In proposed system, the situations of accidents can be reproduced realistically with 3D vision tool programs. The ship model, layout of seaside and other navigation objects such as simple buoys also can be utilized for more realistic vision.

2.3 Display Part

Many participants, such as stator, judge and investigator and so on, attend the marine accidents judgment trial. So it is required to show the situation of accidents to the participants in an open screen. All participants can view the reproduced display on screen as explained in Fig. 1.

3. SYSTEM FUNCTION

3.1 Initial Display of System

The Fig. 2 shows the initial display of the system proposed in this study. The window consists of three part; A, B and C section. The "A"section is main windows where user can selects the sea areas, reproduce speed, store fuction, replay of the accidents between ships. Three of speed options are available for reproduce mode; normal, 3 times and 10 times speed. The "B" section is a display window for ships'data such as speed, heading and so on, when their trajectories are reproduced. Other information for example, the distance and bearing between two ships, also can be found in this window. User can select ship type and size including view point in the "C" section. The ship's trajectories also can be input in this section.

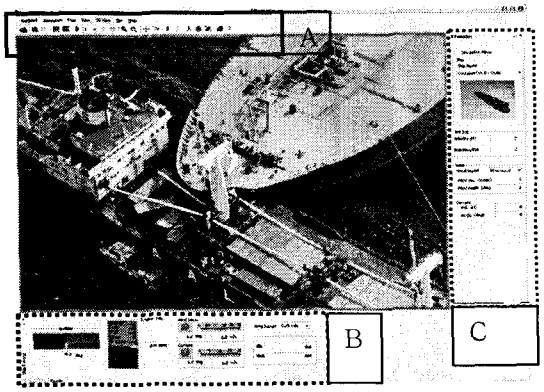

Fig.2. Initial Display of the System.

3.2 Select of Accident Location

To make the system activate, basic function should be selected at first and user chooses the sea areas where the ship accidents have occurred. The Fig. 3 shows the 2D-map supplied by the system. User can easily search and select the accident location with the 2D-map windows. At this moment, the system provides 3 categories for sea areas; south, west and east coastsof Korea offshore. The accident situations are reproduced on this 2D-map. The Fig. 3 shows offshore adjacent to the port of Busan, Korea.

Fig.3. 2D Map Adjacent to BUSAN.

3.3 2D Collision Display

Ships' trajectories before accidents occurred should be input with typing or mouse operation to reproduce accident situation. The Fig. 4 shows snap shot when ship model are selected and ships' trajectories are input by mouse operations. The ships' trajectories in latitude and longitude coordinates are input in the dotted box as shown in the Fig. 4. If ships'trajectory data can be obtained from VTS (Vessel Traffic Service) center, the data will be input into the system through this window. For users convenience, ships trajectories also are input and modified using mouse operation on 2D visual display. When input operation of ships trajectory is completed, the concerned sea areas will be appeared on 2D visual display as shown in Fig. 5. This figure shows the port of Busan, Korea. As shown in this figure, 2D ship contours are displayed and related information between ships are appeared on bottom windows with a title of VRM, EBL.

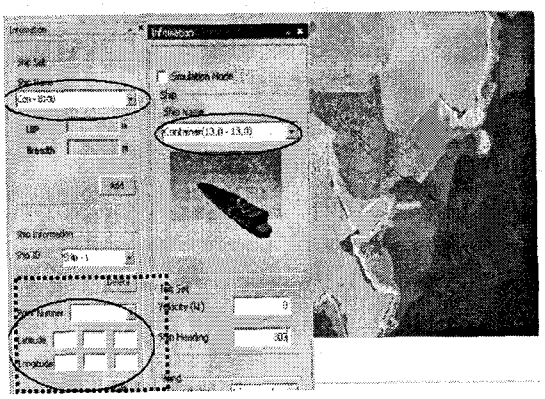

Fig.4. Accident Input Display.

Fig.5. 2D Display for Ship Collision.

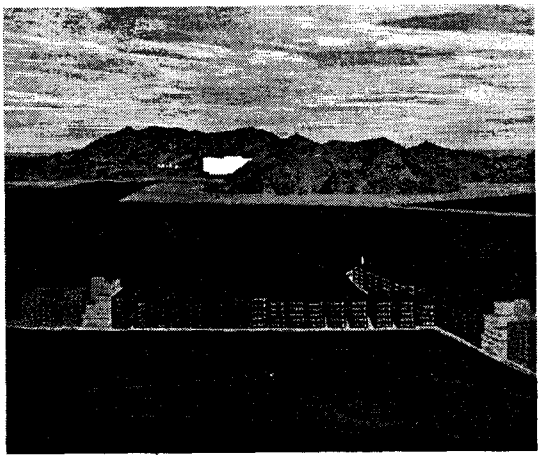

Fig.7. 3D Visual Display for Ship Collision.

3.4 3D Visual Display

In addition to 2D visual display mode predicated in previous section, the situation of ship's accidents also can be displayed in 3D visual mode. The Fig. 6 shows the ship model and environmental circumstances in 3D vision. The view angle is set to the 3rd person's viewpoint with two ships in sea. In other hands, the Fig. 7 also shows the snap shot of 3D visual view for two container ships where the viewpoint is the 3rd person's view angle. This system also provides 3D environmental model such as outlay of port as shown in Fig. 7. It may cause users to feel the display realistic when they operate the system. The inner harbor of Busan port is shown in Fig. 7.

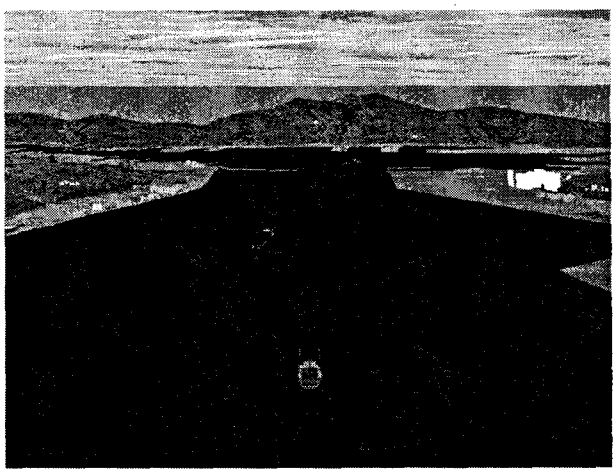

Fig.6. 3D Visual Display of Port.

3.5 3D Ship's Model

The Fig. 8 shows some of ship model built in the system. As shown in this figure, various ship type such as fishing boat, Ro-Ro passenger ship, container ship, LNG carrier and Tanker, are available. Marin accidents can occurs in various ship type and size. Especially the incidence of fishing boat is usually high and its ship type is very wide. Therefore it will be one of import task to build up various ship type and size as many as possible. Further works will be carried out for more sufficient ship model.

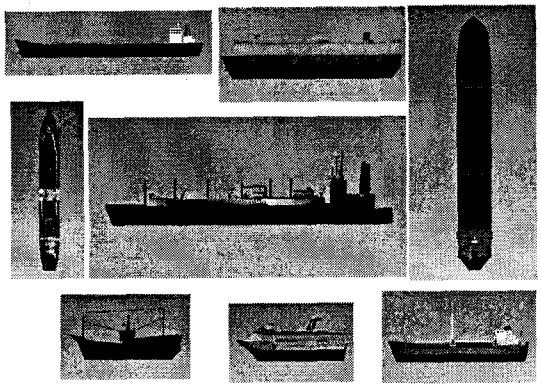

Fig.8 3D Ship's Model Type

4. CONCLUSION

This research is carried out to propose the marine safety judgment system that can be used as a useful tool to provide scientific investigation in trail case of Korean maritime safety judgment. Until now many marine accidents have

been occurred in offshore area of Korea, and the maritime safety tribunal has judged the accidents. The requirement for ㅊmarine safety judgment system utilizing computer and other intelligent system has been increased in Korea. However the level of intelligent technology applied to the marine judgment process is not so high. The proposed system is expected be used as utility that provide scientific and convenient marine judgment process. In the present research, the reproduce of ship collision accidents are based only on input operation of ship trajectories. Further research is needed to develop advanced system that can express ship's dynamic motion characteristics with their rudder and propeller operation.

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