A Predetermination Decision-Making System for Automated Ship Navigation and Collision Avoidance

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1. Introduction
With the integration of maritime traffic, the updating of the navigation equipment, and the rapid development of various collision avoidance technologies, K.Ohtsu and H.-C. Burmeister (2015) discussed ship Autonomous Guidance and Navigation (AGN) and ship Autonomous Collision Avoidance (ACA) systems are becoming increasingly important for seafarers. However, in any system that requires human involvement, a risk of accidents always exists due to mistakes. The operation of maritime traffic navigation is also bound to human error. Therefore, the purpose of this study is to build an autonomous collision avoidance system that can make decisions to avoid accidents and mitigate the risk of human error in marine navigation. We define this conceptual system for the maritime field as the Predetermination Decision-Making System (PDMS).

2. Analyze Human Factors and Explore Methods
In this study, authors discussed how to found an effective method to reduce human error. But the level of training, cultural conditions, mobility, quality, and operational capacity of seafarers will become more uneven in the foreseeable future. Furusho (2006) summarized the four elements of the safety of ships, based on the characteristics of maritime transport system: man, machines, media, and management. Human factors are an important part of ship safety. Therefore, future research will focus on how to minimize human involvement and build more intelligent auto-navigation expert collision avoidance systems.

3. Process of the PDMS
Based on the decision making system theory, put forth PDMS core application processes, by following the flowchart in Fig.1, the authors designed a new model for preventing human error. The most important steps in this model is, autonomous pre-decision. If there is a collision risk at some point in time, then the system monitors whether appropriate actions are taken by the OOW; if the OOW does not take appropriate action and the ship cannot maneuver to avoid the collision risk in the time required, then the system can take autonomous control to avoid the danger.

4. Investigation at the Seto Inland Sea
In order to study the actual conditions of ship encounter

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Fig.1 Collision avoidance flowchart
called “Fukae Maru”. The observation and collecting data were performed in the Seto Inland Sea. Through data collection and analysis, authors screened out 50 encounter situations approved by the Convention demanded. Analyzed, just 8% belongs overtaking situation. But Even the overtaking just 8%, Study shows most accidents occurred because the OOW not clear the encounter situation belongs overtaking or not. Therefore, using this system to make deductions is a good attempt to prevent human error.

5. Conclusions
Predetermination Decision-Making System (PDMS) can calculates a variety of forms of a ship’s potential encounter situations. The main results of this article as follows:
1. This model can make a relatively accurate prediction and assist the officer of the watch (OOW) making an appropriate decision.
2. Even if human (OOW) is involved, this model can calculate the human factors as a node parameters counted and make a prediction; in the situation that no OOW is involved or the OOW take an inappropriate action, this model can remind or assist the OOW to take the correct action seasonable.
3. Once there is no response and indeed have a collision risk based on the calculation of this model, also can provide an optimum navigation adjustment.

References