Mariner's Performances and the Fluctuation Affecting on Navigation Safety

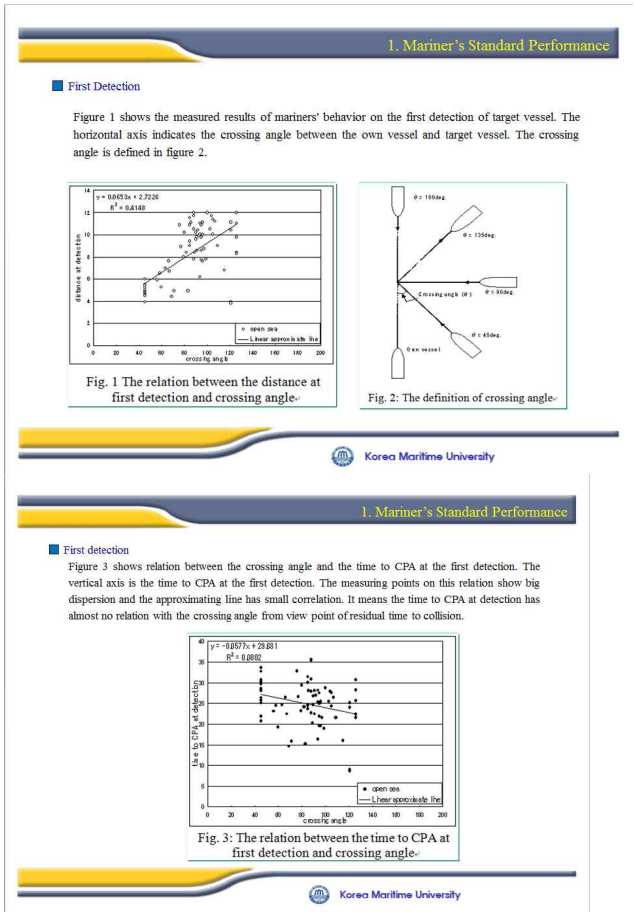
Chae-Uk Song*, Hiroaki Kobayashi**, Tae-Goun Kim†

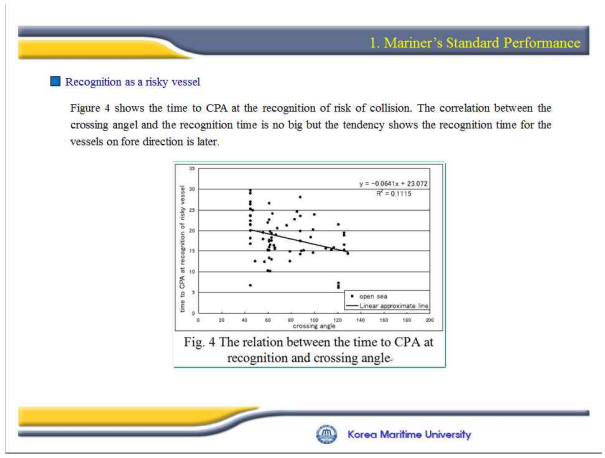
* & † Korea Maritime University

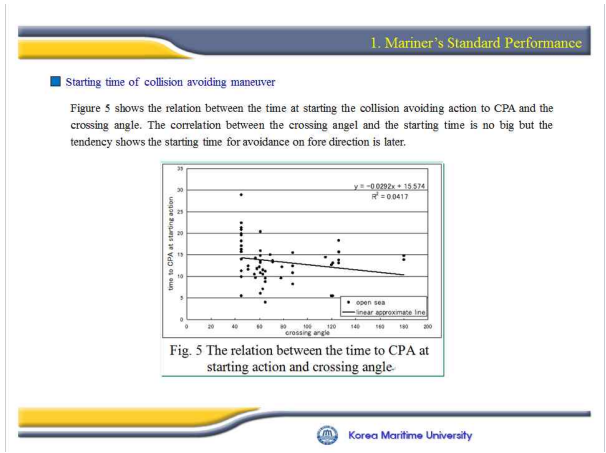
** Tokyo Univ. of Marine Science and Technology

요 약 : This study aims to identify the degree of safety when mariners take their actions in several different situations. We have carried out many experiments in order to observe mariners' behavior, and then measured the safety level that is based on their actions to avoid dangerous collision situations. One of the most important actions that mariners have to take, either as their daily routine or when they are in a collision situation and then want to avoid that situation is the lookout. In this paper, behaviors on the lookout have been defined as a standard sequence of three steps that are "time of first detection", "time of recognition as risky vessel" and "time of starting avoiding action", and the suitability and applicability of the definition have been shown. And also we propose the risk assessment on the collision and the recommendation for reducing the collision at sea. Some analyzing results and the application of the results are reported. The sequence of lookout is also understood. By combining these knowledge and some systematic studies, we propose the risk assessment on the collision and the recommendation for reducing the collision at sea.

핵심용어 : Mariners' Behavior, Safety Level, Standard Sequence of Lookout







* 주저자, songcu@hhu.ac.kr

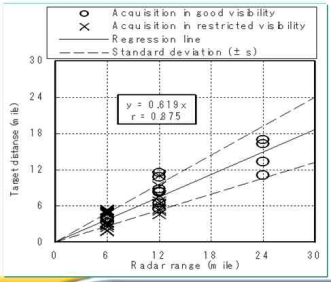
** 공동저자, kobayasi@kaiyodai.ac.jp

† 교신저자, teddykim48@hhu.ac.kr

2. Fluctuation of Mariner's Behavior

■ Change of detection caused by visibility

Figure shows the relation between the first detection and the visibility. Generally, mariners use shorter range in the restricted visibility and detect the target at shorter range rather than fine visibility. They detect the target in restricted visibility at half range of the first detection in fine visibility.



2. Fluctuation of Mariner's Behavior

■ Change of time of recognition on collision risks by traffic density

The change of recognition time due to the traffic density is shown in figure 9. It shows no changes to the traffic density. It is one of possibility that they pay attention on the target after they detected them and recognize the risks through continuous observation. The time to recognize the risks should be 15-20 min. before collision. In case of heavy traffic condition over 4 ships in vicinity, mariners have to judge the risks of collision within 2 min. or right after detection.

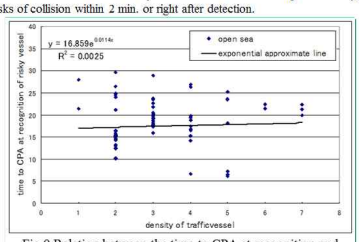


Fig 9 Relation between the time to CPA at recognition and traffic density

2. Fluctuation of Mariner's Behavior

■ Change of detection caused by traffic density

Traffic density is defined as showing figure 7 that define the number of the vessels in the vicinity. The area of vicinity is defined by the circle with 3 miles of the diameter and own ship's position is 2 miles behind of the center of circle.

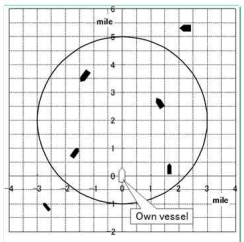


Fig. 7 Definition of Traffic Density in Vicinity.

3. Mariner's Factor and Navigational Condition

■ Necessary condition of safe navigation

Firstly, the condition of navigational environment are discussed and it is mainly decided by following items,
- Maneuvering characteristics of own vessel
- Water area for navigation
- Weather and sea state
- Traffic condition (kinds of traffic vessels and the density)
- Condition of traffic rule

Secondly, the characteristics of human ability on ship handling are explained. The competency human operator shows is mainly decided by following factors,
- Mariner's license rank
- Experiences
- Fatigues (relating to the elapsed time of standing watch)
- Tension (relating to the time of watch)

2. Fluctuation of Mariner's Behavior

■ Change of detection caused by traffic density

Figure 8 shows the relation between the time to CPA at first detection and the traffic density. The detection time is also changeable due to the workloads of mariner. They cannot keep sharp lookout when they have to achieve many tasks such as positioning, communication and so on. Especially in case of heavy traffic condition, they have to pay attention on many vessels in the vicinity. Usually, they pay more attention on the vessels near by rather than ones in far area. And then they cannot achieve sufficient observation on the vessels in far area, the detection on the vessels may be late.

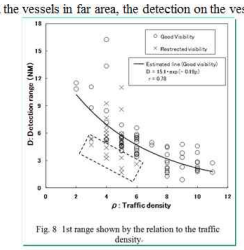


Fig. 8 1st range shown by the relation to the traffic density.

3. Mariner's Factor and Navigational Condition

■ Accident occurrences and its condition

Figure 10 shows the relation between the competency required by environment to accomplish safe navigation at the condition and the human competency. The line with an incline of 45 degrees indicates the equivalent condition between them. Normal navigation is carried out in the condition of upper part of this line. They are safe situation. In the lower zone of this line, it shows a dangerous situation as occurrence of accident.

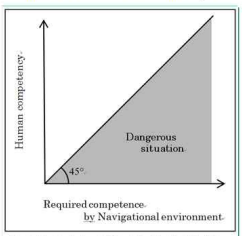


Fig. 10 The Navigational Safety defined by Both Condition of Human Competency and Required Competency by Navigational Environment.

■ Accident occurrences and its condition

Figure 11 shows the situation of Figure 10 with the fluctuation of both factors.

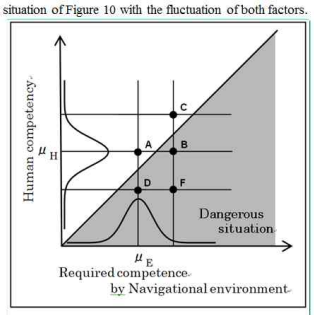


Fig.11 The Change of Safety Degree relating to the Probability of Human Competency and Required Competency

The degree of safe navigation is decided as mentioned in previous section. When the navigational condition shows specific situation, safety degree is decided by mariner's performance. The experienced mariners show the standard performance shown in section 1. When the difficulty of navigational condition is higher than standard mariner's competency, the maritime accidents may occur.

However standard mariner's performances shown in section 1 are the mariners' behavior in the specific navigational condition, the behaviors are changeable due to the condition shown in section 2. Therefore when we discuss the safety degree of navigation, we have to take the fluctuation of mariner's performance into account.

The fluctuations of mariner's behavior shown in this paper are caused by the change of the navigational condition but the fluctuations appear caused by mariner's situation. When mariner becomes tired, mariner shows lower awareness and may execute later detection. The fluctuation deviating from standard performance is also shown caused by the different mariner's competency. We have to study about the fluctuation of mariner's competency when we estimate the safety degree of navigation in actual maritime activities.