Research on Inland Ship Collision Risk Entropy Model-Based-Complex System

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Abstract
This paper reveals the fragile relevance between the crashes uncertainty on ships’ running system and three subsystems which include human, ship and environment, and builds an entropy model of ship collision risk. Here inland collision causation mechanism and the character of inland maritime accident are studied mainly to identify the key factors, which would impact the subsystems in ship collision. Moreover, the crash factors and implicit association among them are also researched. The established model could not only demonstrate the impact of the collapse of the various subsystems of inland vessels in a collision but reveal the interaction between each subsystem, which will provide a new solution for the inland ship collision avoidance.

KEY WORDS: Inland Ship; Collision Risk Entropy; Complex System.

INTRODUCTION
The water traffic accident statistic shows that the probability of ship collision accident is larger than other accidents. According to Lloyd’s register of shipping (Chen et al. 2006), the number of the collision accident in the world is more than 10% in all kinds of sea accidents every year. In the literature (Yip et al. 2008), 54% of the water traffic accidents which happened in Hong Kong belong to collision from 2001 to 2005. Except that, the statistics show that in Gulf of Finland (GoerlandtF et al. 2011) collision accident accounts for 20% of all water accidents.

Considering that inland navigation environment is more complex, the probability of ship collision accident is bigger. For example, in the main channel Yangtze River which is the world’s busiest inland river, there are 162 traffic accidents or dangerous situations happened which cause 31 death and 14 sinking vessels (the data comes from Changjiang Maritime Safety Administration in 2014), and all various accidents have been shown in Fig.1. It is seen easily that collision accidents account for more than half the number of total accidents.

Based on the statistical analysis of collision accident in the Yangtze River, this paper extracts the collapse factors of manned system, vessel system and environment system in total collision processes, and then reveals the correlation between each subsystem and the effect on vessel collision system by complex system’s brittleness and set-pair analysis method.

INTRODUCTION

PROCESS ANALYSIS OF INLAND SHIP COLLISION

Because the waterways of inland waters is narrow, and maritime traffic is dense, so ships sailing in the waterways can often meet the case of encountering other ships. If the ship can’t keep the safe distance to pass with other ship or avoid actions unsuccessfully, the collision accident will occur. Learning the process of ships from judge encounter situation to take avoiding action and then to occur a collision or avoid successfully, it can contribute to further analysis the success of inland ship collision avoidance. The evolution of the encounter situation for inland ships can be expressed in Fig. 2(Zheng et al. 2000).

![Fig.2 Encounter process of inland river ships](image-url)