Study on decision-making of Ship collision avoidance

Shijie Yan

Marine college of Shandong jiaotong university, Weihai , Shandong, China

yanshijie@163.com

Keywords: Ship collision; collision avoidance decision-making; risk of collision; multi-ship encounter

Abstract. Ship collision, not only damaged the hull, threatening the goods, or even in a boat crash, serious marine pollution. The reason, is not difficult to find the vast majority of crashes are caused by voyagers negligence, negligence and serious violation of international regulations for preventing collisions at sea. Thus, reduce human errors is to reduce collisions and improve key aspects of the safe navigation of ships. Ship collision avoidance decision-making is an important 21st century marine technology research topics.

Introduction

Ship collisions in water remains relatively high rates of traffic accidents. How to avoid collision between ships is the important link to ensure the safe navigation of the ship, is the prime duty of drivers in the navigational watch.

As we all know, on ship collision studies has a long history, although also had many results, but so far, all traffic accidents at sea, number of collisions are still top. According to Lloyd's global accident statistics from 1995 to 1996, there were 367 (1.8 million gross tonnes) complete loss of ships, of which 33% is lost because of collision and grounding of the ship, while the total tonnage of these ships accounted for losses of 46%. In addition, according to the 2000 China water variety of shipping accidents and accidents on the cause of the accident data in the table can be found in all types of shipping accidents in the highest proportion of collisions. This shows the importance of study on ship collision avoidance decision-making.

Practical work of the international regulations for preventing collisions at sea guide has some limitations. International regulations for preventing collisions at sea at a macro-level specification for ship collision avoidance behavior, reduce the uncertainty of the ship and mutual misunderstandings, to prevent and avoid collision has played a guiding role. But have to point out is: international regulations for preventing collisions at sea only contain articles and provisions of principle, cannot be issue-specific specific collision prevention programmes, and ship staff understanding of the collision regulations will vary. Therefore, for ship collision avoidance decision-making further study is also very necessary.

Basic mechanism of ship collision avoidance

Ship collision avoidance areas are a subject to the constraints of the 1972 international regulations for preventing collisions at sea, while applicable to seafarers ' normal practice area. Ship collision domain knowledge includes both legal provisions and technical knowledge.

Ever since the shipping, human research on ship collision is never stopped. As early as the era of sailing, society of people for ship maneuvering characteristics of each other in case of collision avoidance technology, and lessons from the crash, made some technical rules, and formed will encounter geometry (also known as collision geometry) initial principle. In order to avoid collisions caused significant loss of life and property, but also in order to determine the liability of the parties after the collision accident, various maritime countries continue to have dual nature of legal norms and technical regulations for preventing collisions at sea rules.

Due to internationalization of maritime, the first international regulations for preventing collisions at sea and come into operation in 1910. Subsequently, for preventing collisions at sea research

focuses mainly on interpretation of the international regulations for preventing collisions at sea, apply, and modify. As the ship collision avoidance equipment such as radars, drawn towards the automatic radar detector (ARPA), VHF and AIS (automatic identification system) have been installed and used, and the views of people using information theory, systems theory and cybernetics research issues for preventing collisions at sea, depth and breadth of ship collision avoidance study is in the process of continuous development.

Navigation officer on watch looking through the gap found after boat, gathering to marine-related campaign information, and analytical processing of collected information. Subsequently, the driver to judge whether two vessels can safely pass, if action is taken until the pass; if not safe passage, the pilots determined in accordance with regulations for preventing collisions at sea will encounter patterns of the two ships and specifically avoiding responsibility. This ship was a giveaway, the judge should take action to avoid collision; avoiding manipulation and then until leaving Qing, the ship resuming service, collision avoidance process is not complete.

Collisions are less than the distance between the vessel and the target safe passing distance required by the target, in order to avoid collision, the target should always be greater than the distance is correct.

To control this target distance, which control the State will face. This will state, can rely on the vessel or the objectives of the action goes (An or Bn) to control. According to this method of control, collision avoidance can be divided into the following two methods:

1)coordination collision law

An and Bn both mutually controlled object methods, representatives of this approach is that traffic control.

2) autonomy collision law

Will be some aspect of An or Bn as a method to control this object, sailing is An avoidance of control collision avoidance method.
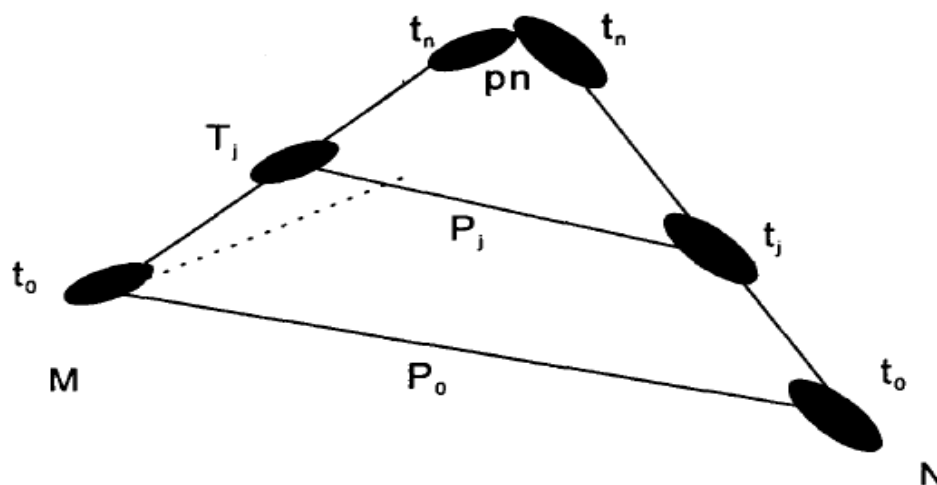

Fig . 1 the collision point location change of Two ships

Collision risk calculation based on fuzzy theory

Vessel collision risk degree is the basic concepts in the field of ship collision avoidance, is engaged in ship collision research scholars be able to evade the issue. On collision risk assessment is the focus of this paper. Due to the ambiguity of ship collision risk, uncertainty, study at home and abroad, there is no generally accepted method of measurement. International regulations for preventing collisions at sea several references "collision risk", but no strictly defined. In addition, the marine court, when dealing with the case, although the circumstances under which two ship collision risk to define sexual explanations, that when two vessels are very close, so when a shipping mistake can result in collisions, two ship collision risk, but it defines the interpretation of qualitative concept of ship collision risk.

Practice has shown that the collision risk in addition to DCPA and the TCPA-related things, and maneuverability of ships, as well as factors such as visibility, shipping scales close links. Comprehensive consideration of these factors is essential to correctly judge the ship collision risk. Establish the collision risk evaluation model for this this article taking into account factors such as ship manoeuvrability and visibility, method using fuzzy theory of ship collision risk evaluation model.

To date, involve risk of collision-a lot of research papers, based on vessel collision risk degree determination standards, it may be divided into two categories, one is the objective possibility of collision between ships on, that according to certain objective indicators for the evaluation of possibilities of collision between ships. At the time of determining the collision risk, the selected indicators are objective indicators will ship in a particular case, the ship will encounter geometry elements are objective facts that do not take the person's will as to transfer. Therefore, it does not take into account driver awareness of the situation; the other is in the driver felt the collision risk in a particular situation, the so-called subjective collision risk. Subjective risk of collision are drivers in a specific situation for objective awareness of the dangers of collision and to reflect, subjective collision risk considering the pilot's experience, risk tolerance, personality factors, such as collision.

Decision-making of ship collision avoidance

International Shang for has many research, although research of method different, selection of ships type and the size, different, but are of conclusions is is basic consistent of, that: first, in accident (including collision accident) in the, man-made factors of role is is key of; second, very needs involves man-made factors aspects of various system information and the information; third, as strategy measures, to reduced collision accident, future will appears global of common inputs.

A. Human dimension of ship collision avoidance decision-making process

First, in the collision of ship pilots should have various messages.

Secondly, the collision avoidance control processes.

B. The ship's factors of collision avoidance decision-making

Macroscopic study of collision avoidance and collision accident, comparative analysis of the relationship between size and collision rate of ships more, also get a lot of useful conclusions. In General, when in good visibility, even if environmental conditions improve, shipping accident rates higher than the boat.

In terms of speed and maneuverability of ships, larger factors impact on ship collision is: ship speed, ships into the margin, slow strokes, and so on.

C. Environmental factors in the collision avoidance decision-making

Ship navigation environment with impact on the situation of ship motion at all times, kept the ship pilots provide stimulus signals, are the basis of collision avoidance decision-making of ship pilots. As we all know, different traffic environment determines the different patterns, different ship transport ships, and varying degrees of influence on the ship collisions. Such as in the gut when a collision, collision avoidance actions the meaning and in the absence of substantial prejudice or unrestricted Ocean meaning substantially different, and collision avoidance action taken together are not exactly the same. Therefore, when studying the ship's collision avoidance action, you must fully take into account the impact of environmental factors. Environmental factors include: natural environment and navigation environment factors.

There in the boat when the collision risk, rules for ship collision avoidance action taken by was not applicable. However, for the ship collision risk one of multi-objective goals, and the ship is probably the rule, which is formed between a particular situation, shipping will still be under the provisions of rule, take the appropriate action. From the standpoint of his boat, requiring the vessel collision avoidance rules according to take collision avoidance action. In this case, to the requirements of his boat on the ship and the vessel actual requirements for the vessel operations on the situation in the conflict. In addition, when the ships and more ships will encounter and collision risk when taking

collision avoidance maneuver, between his ship and must take into account the possible encounter situations and possible manipulation.

According to the international regulations for preventing collisions at sea, to take full account of ship collision risk requirement, many ships will make the following solution to be able to take full advantage of radar on the basis of information, ensuring collision avoidance method of flexibility and uniqueness of the best collision avoidance scheme, this method can be called a "collision prevention focused on the ship" manipulation methods.

In the theory of artificial intelligence, in order to solve some practical problems, made a number of algorithms and search strategies, such as "blind hill climbing method", "depth-first law", "breadth-first method" and so on. When there are local solutions and optimal solution for cases, many algorithms or search strategies, can be found locally optimal solutions, and does not necessarily guarantee the global optimal solution. In ship collision avoidance maneuver, also have the same problem, if only in a particular boat after being formed, again considering collision avoidance strategy, the resulting policy is not necessarily the optimal solution, most can only be a locally optimal solutions. Therefore, to achieve the so-called "breadth-first search strategy" and "depth-first policy" combination is very important.

References

[1] H.Imaxu,T.Koyama. Determination of times of collision avoidance. The Journal of Japan Institute of Navigation,2009,70:30-37

[2] K.D.Jones.A comparision of facilities on computer based radar. The Journal of Navigation. 2008,29(3):232~237

[3] T. Macduff. The probability of vessel collisions. Oecan industry, 2007.Sep.:144-148

[4] A.N.Coekcraft. Statisties of ship collisions. Journal of Navigation. 2008. 31

[5] Bryan Ford,Pyda Srisuresh,and Dan Kegel.Peer-to-Peer Communication Across Network Address Translators.In USENIX Annual Technical Conference,Anaheim,CA,April,2005.

[6] Zhao jinsong. ship collision avoidance principle. Dalian: Dalian Maritime University Press, 1999

[7] Zheng Zhongyi, Wu Zhaolin. multi-ship collision avoidance decision-making research. marine technology, 2000,4:9-12

[8] A. Cavoukian, J. Stoianov. A Positive-Sum Technology that Achieves Strong. Authentication, Security and Privac. 2007,(3)