Sample Translation

Ocean Engineering

- See below for the original Chinese manuscript.
- **A native-speaker of English who has studied this field** proofreads the translated English (colored).
- The quality of the translated manuscript is suitable for publication in an international journal.

Study ofn Fuzzy Theory and Geographic Information Systems and Their Application toon Safeg Guarding for Navigation of Fishing Vessels

Abstract

In recent years, the marine casualties of fishing vessels haveare often heard appeared in the maritime ship collision incidents, with the major causes are being human errors and unperceivable unpredictable conditions. TSo, this study tries aims to create a set of collision-avoidance guarding modemeasures for the operated fishing vessels through the angleby way of of time and space management. It will propose a new safe collision-avoidance guarding ring for the navigational safety between the operated fishing vessels and merchant ships, which enablesenabling the fishing vessels to perceive establish the dynamic state of approaching the operated ships, in order to avoid colliding. This study utilizes the maximum relative speed and relative bearing amongbetween the fishing vessels and merchant ships as the reference value of space, and the escape time of fishing vessels as the reference value of time. These three items are used as the linguistic input variables of fuzzy control theory. AfterFollowing it isa calculationed and solved, a radius of safe guarding ring radius is obtained, which is then shown on the platform of marine geographic information systems (GIS) in accordance with the actual proportion. After a lot ofFollowing simulation analyses, a safe collision-avoidance guarding mode for the operated fishing vessel is created. In addition, in order to further determine the danger relationship for the collision of two ships, the area difference calculated through GIS is used as the evaluation basis for a danger index of for two ships. It is expected to promote the collision-avoidance guarding energy of the operated fishing vessel effectively, raise improve the safety of fishermen for the operation on theoperating at sea, and reduce the occurrence of marine casualtiesy for merchant ships and fishing vessels.

Keywords: Fuzzy theory, marine geographic information systems, safe guarding ring, danger index

1. Introduction

Taiwan is surrounded by sea on all sides, the natural environment is superiorremarkable and, the long coastline is made up of numerous coral reefs. It containsOn account of the abundant marine fisheriesy resources, t. There isare a lot large number of harbors and fishing vessels. The fishery resources haFishing has ve become the most important economic activity and the people'sprovides a livelihood industry for many people in Taiwan area. In order to promote the navigational safety and information transmission ability of maritimene transportation, the International Maritime Organization (IMO), International Association of

Lighthouse Authorities (IALA), International Telecommunications Union (ITU) and International Electronic Committee (IEC) participated in~~ the setup for~~setting up the equipment for the~~of~~ A~~a~~utomatic I~~i~~dentification S~~s~~ystem (AIS). It was stip~~m~~ulated that CLASS A AIS should be installed for ships ~~more than~~over 300 tons~~nages~~, and CLASS A AIS should be installed for ships less than 300 tons~~nages~~. ~~Our~~ The Taiwanese government has not enforced the installation of CLASS B AIS on all fishing vessels because ~~to install CLASS B AIS,~~ the small-scale fishing vessels ~~have~~ do not have AIS transceiver function. ~~When the~~When such fishing vessels and merchant ships collide,~~ the~~ merchant ships with AIS are~~is~~ unable to provide the necessary collision-avoidance information to the crew of fishing vessels effectively~~, which often causes the marine casualty of collision~~.

~~All the time, the m~~Marine casualties~~y~~ of fishing vessels are~~is~~ ~~occurred constantly~~a regular occurrence. According to Article 2 of the "Disasters Prevention and Protection Act", ~~the~~ "marine casualty" ~~is one of calamities~~disasters are mainly dealt with ~~rescued~~ by~~ our~~ government authorities~~y mainly~~. The "Enforcement Rules of Disasters Prevention and Protection Act", promulgated by the Ministry of Interior and the "Operation Plan for Prevention and Protection of Marine Casualty", promulgated by the Ministry of Transportation and Communications, ~~the definition~~define~~ of~~ marine casualty as~~is~~ the breakdown, foundering, stranding, collision, fire, explosion, or~~and~~ leaking of a ship or other extraordinary accidents associated with a ship, its~~,~~ crew or its passengers~~ ship~~.

Ships include but are not limited to, ~~various types of ship, such as~~ cargo ships, passenger ships, fishing vessels, and ~~public affair~~government ships~~ etc~~. According to~~ the~~ statistical data from~~of~~ the Ministry of Transportation and Communications [1], the major causes for marine casualty of fishing vessels in ~~our country~~Taiwan are "mechanical~~achinery~~ breakdown", "fire" and "collision", which accounted for 81.2, 23.5 and 16.7 ships in ~~recent~~ the past six years, respectively. Among them, a serious accident of a "collision ~~of~~ between a cargo ship and fishing vessel"~~ was~~ occurred ~~at the sea area of~~off Keelung Islet,~~ in~~ Taiwan on January 5, 2008 between~~. When~~ the fishing vessel~~ of~~ "Pacific Ocean 168", which was sailing around the Islet, ~~sailed to the adjacent place around Keelung Islet,~~ and the cargo ship ~~of~~ "Country Rich Carrier", which lay behind the~~ Keelung~~ Islet. Although the radars of both ships were scanning the sea surface continuously, only~~ the~~ Keelung Islet could be seen on the screen~~ due to the influence of obstacle~~. U~~ They were u~~nable to see each other until ~~. When they found the other ship,~~ it was too late,~~ and~~ the occurrence of a marine casualty was unavoidable. ~~The operation of fishermen is~~Operating fishing vessels frequently drift~~ed on the~~at sea. If the ~~in-charge~~on-watch crew of merchant ships neglect~~s~~ to ~~watch the sea surface~~keep a good lookout, ~~the marine casualty of~~ collisions ~~will be~~can occur~~red~~ due to human error~~, which will cause the significant regret~~.

Collisions may not be the only accident~~s can be~~ caused by~~ the~~ merchant ships~~, but~~. They can also cause ~~the capsizing and net shedding of~~ fishing vessels to shed their nets or capsize. F~~ The f~~ishing vessels and merchant ships differ in many ways~~ is different from general merchant ship~~. When~~ the~~ merchant ships~~ is~~ approach~~hing the~~ fishing vessels, the resulting wake can affect the~~the~~ operation of fishing vessels and can result in net shedding or capsizing.~~ The capsizing and net shedding of fishing vessel will be occurred.~~ If~~ the~~ fishing vessels are~~is~~ unable to send out~~ the~~ guarding messages in time,~~ a lot of~~ marine casualties~~ of~~

~~fishing vessel~~ will ~~be occurred~~result. At present, the safe collision-avoidance guarding mode for ~~the operated~~operating fishing vessels has not been created domestically and t~~. T~~here are ~~a~~ very few domestic ~~and~~or ~~foreign~~ international scholars researching~~study~~ this topic. T~~So, t~~his study shows~~depicts~~ that it is necessary to create a~~the~~ safe collision-avoidance guarding mode for fishing vessels. First, AIS receivers are employed to set ~~the~~ safe collision-avoidance guarding modes for ~~the~~ operating~~ed~~ fishing vessels ~~first~~. After it is stipulated by the law, CLASS B AIS can be installed in order~~the fishing vessel,~~ to improve the navigational safety of ships. The safe collision-avoidance guarding mode for ~~the~~ operating~~ed~~ fishing vessels proposed by this study can be widely applied ~~in the operated fishing widely,~~ and the marine casualty of fishing vessels will be ~~reduced~~ greatly reduced for ~~the~~ future statistical investigations ~~of the marine casualty in the future~~.

模糊理論與海洋地理資訊系統應用於　漁船航行安全警示之研究

摘要

近年來，在船舶碰撞事件上，漁船海難時有所聞，探其原因多歸咎於人為疏失與無法察覺。因此，本研究擬建立一套作業中漁船安全避碰警示模式，藉由時間與空間管理之角度切入，針對作業中漁船與商船之間的航行安全提出新的安全避碰警示圈，使作業漁船能警覺接近中船舶之動態，避免發生碰撞。本研究主要利用漁船與商船間最大相對速度及相對方位為空間參考值，結合漁船各類漁具漁法之相異脫逃時間為時間參考值，以此三項為模糊控制理論的輸入語意變數，經解算後，得出安全警示圈之半徑，再依實際比例顯示於海洋地理資訊系統平台上，經由多次模擬分析後，完成建置作業中漁船安全避碰警示模式。另外，為了進一步研判兩船間的碰撞危度關係，透過 GIS 快速解算面積差之能力，作為兩船間危度指標的評量依據。期望有效地提昇作業中漁船安全避碰警示的量能，提高漁民在海上作業時的安全，以期降低商船與漁船海難事故發生。

關鍵詞：模糊理論、海洋地理資訊系統、安全警示圈、危度指標

一、前言

台灣四面環海，天然環境優越，海岸線十分發達，四周珊瑚礁石密布，蘊藏著豐富的海洋漁業資源，港灣漁船為數甚多，使漁業資源成為台灣地區重要的經濟活動及民生產業。為提昇海洋運輸的航行安全，國際海事組織(IMO)、國際燈塔協會 (IALA)、國際電信聯盟(ITU)及國際電子委員會(IEC)等，共同參與船舶自動識別系統(AIS)的設備制

定，以提高船舶航行安全及訊息傳送能力，且規定 300 噸位以上船舶需裝設 CLASS A；300 噸位以下裝設 CLASS B。礙於我國政府尚未強制推動漁船皆需裝設 CLASS B，小型漁船並無 AIS 收發機之功能，且當漁船與商船發生碰撞時，裝設 AIS 之商船無法有效提供船舶避碰資訊給航行人員，造成漁船海難碰撞事件之發生。

一直以來，漁船海難事故不斷發生，根據我國「災害防救法」第二條條文指出「海難」為我國政府機關主要防救之各類災害之一，至於我國政府主管機關對「海難」之定義，依據內政部所發布之現行「災害防救法施行細則」，以及交通部依據「災害防救法」所制訂之「海難災害防救業務計畫」，皆將海難定義為：船舶發生故障、沉沒、擱淺、碰撞、失火、爆炸，洩漏或其他有關船舶、船員或客船之非常事故。

由於上述海難所涉及的船舶包括貨船、客船、漁船、公務船舶等各式船舶。由交通部統計資料顯示[**Error! Reference source not found.**]，我國漁船海難事故中，「機器故障」、「失火」及「碰撞」列為三大類型，近六年平均肇事漁船數分別為 81.2、23.5 及 16.7 艘。其中，2008 年 01 月 05 日發生在台灣基隆嶼海域的「貨輪撞漁船」海難重大事故，主要原因係漁船「太平洋 168 號」航行至基隆嶼附近，而貨輪「國富號」位於基隆嶼後面，兩船雷達雖不斷掃描，但受到障礙物影響，螢幕上僅看到基隆嶼，無法掃描到彼此回跡，一等發現對方，為時已晚，海難事故已無可避免。漁民在海上漂泊作業，由於本身專注於捕魚作業或商船航行當值人員的人為疏失及耽於航行作業，而造成船舶碰撞海難事故的發生，甚至商船碰撞漁船前後仍有渾然不知之情況，造成無法適時補救的重大遺憾。

漁船海難不僅只有商船所造成的碰撞事故，商船會遇對作業中漁船亦會造成傾覆及脫網之海難事件。肇於漁船有別於一般商船，當商船接近漁船時，往往因航跡流及俥葉流效應造成海面上產生波浪而影響航行中漁船作業，使運轉受限制作業中漁船造成傾覆及脫網，且漁船本身無法適時發出警示，致使漁船傾覆之海難事故層出不窮。惟目前國內未建立作業中漁船安全避碰警示模式，國內、外探討此議題的學者也非常少，因此，本研究認為漁船航行安全警示的建立是有必要的。本研究先以 AIS 接收機建置作業中漁船安全避碰警示模式，待法律制定後，將可裝設至漁船 CLASS B，提升船舶間航行安全，藉由本研究所提出作業中漁船安全避碰警示模式，以廣泛運用在作業中漁船，而使未來在海難事故調查的統計上，漁船的海難事件能夠大幅降低。