Vessel Collision Avoidance System (VCAS) Based on AIS Data

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***Abstract* - In Indonesia, Maritime transportation delivers more than 71% of 96% to international trade in the world. It is a huge contribution to Indonesian economy. But, it is in contrary in the matter of safety. Based on National Transportation Safety Committee, there are 31 marine accidents, and around 25% of them is ship collisions which caused by human error. Accordingly, the research proposes a design of Vessel Collision Avoidance System (VCAS) based on AIS data as the input of vessel identification trajectory by using Fast Patrol Boat. As the result, this paper simulates Fast Patrol Boat maneuvering to prevent collision with another vessel.**

***Term Index* - AIS, Collision Avoidance**

INTRODUCTION

The efficiency of marine transportation especially for cruise shipping is affected by maritime weather. The irregular pattern of weather holds a certain possibility to trouble the shipping efficiency. Some of the causes triggering shipping accident are human error as much as 41%, force majeure 38%, and hull structure 21% (MTI, Volume 2, 1-2-3 Langkah, 2007). Java Sea Water especially which spreads in the northern region of Java Island among Surabaya, Semarang, Banjarmasin and Makassar is a crowded shipping lane. Some of the considerable harbors such as Tanjung Perak in Surabaya and Tanjung Emas in Semarang serve high frequency of loading and unloading of passenger and goods. Based on the statistical data published by The Ministry of Transportation, the flow of shipping call in the operational area of *PT. Pelabuhan Indonesia III* covering the harbors in Central Java, East Java, and South Kalimantan since 2005 is increasing every year and in 2009 it reached out 72,480 units (Ministry of Transportation, 2009). In 2014, the Government launched a program named *Pendulum Nusantara* which aimed to extend the shippin In Indonesia, Maritime transportation delivers more than 71% goods and people of 96% to the international trade in the world [1]. Therefore, it contributes a huge advantage to Indonesia's economics. For the reason, maritime technology develops quickly. But, it is in contrary in the matter of safety. In the last 5 years, the marine accidents in Indonesia are clustered into high level. According to the investigation result of the National Transportation Safety Committee (NTSC), there are 31 marine accidents in sea transportation, which are 8 incidents caused by collision or 25.8% of the total number of accidents. Mostly, 45% incidents were caused by human error, 38% by natural disasters (*force majeure*) and 21% by the structure of the ship (*hull structure*) [2].

Therefore, modern management of sea transportation which integrated is needed to decrease sea transportation accident. The system consists of system improvements based on navigational system, policy and safety cruise, cruise business management modernization and development of related industries [4]. In order to support the integration system, the AIS (*Automatic Identification System*) technology was installed in several type and size of ships. Currently, the technology is installed to support monitoring system in sea transportation. But, there is a several weaknesses encountered the technology. In this case, AIS could not give recommendation about direction and speed of the ship to avoid accident (crash, sail, or at the forbidden zone) [1].

Accordingly, development of early warning of Vessel Collision Avoidance System (VCAS) is needed to improve the navigational system in the ship. The system will give a response of maneuver should be taken, to avoid collision between vessels in the sea. The advice include in several positions of risk collision position based on IMO through Convention on the International Regulations for Preventing Collision at Sea (COLREGs).

METHOD

The research concerns in Fast Patrol Boat to design of Vessel Collision Avoidance System (VCAS). The principal dimensions and the isometric of the ship lines are shown in figure 1 and Table 1.

Table 1. Principel Dimensions of Fast Patrol Boat

Item	Prototype	Model
Length of Perpendicular	42,60	3,28
Breadth (B) in meter	7,80	0,6
Draft (T) in meter	1,70	0,13
Depth (H) in meter	3,50	0,27

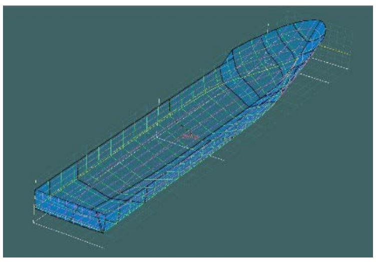

Figure1. Three-dimensional from of Fast Patrol Boat.

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In the designing of VCAS, divided into several modules, those are

(1) Module of searching data input
(2) Seakeeping behavior
(3) Collision avoidance model
(4) Numerical modeling of vessel maneuver

Those modules are integrated in system which presents a decision about collision and described in figure 3. In the process, the research takes several data information, are:

(1) Design of Wet Areas: ship maneuvering and hydrodynamic behavior, approach channels, maneuvering areas within the port.
(2) Marine environment factor :average of the speed and direction of ocean currents, wave height, speed and direction of wind.
(3) Type of Fast Patrol Boat: Dimensions, and speed
(4) The coordinates of the position of the dock.

RESULT AND DISCUSSION

The simulation gives result to illustrate manoeuvrability of head-on situations between reference vessel; a Patrol Boat with target vessel, in standby position and moving. Illustrated between patrol boat and another vessel, in which is described figure below.

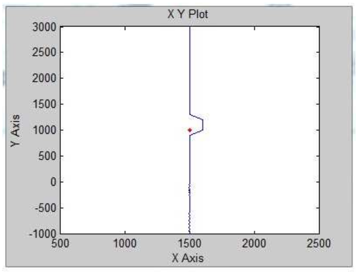

Figure 2. Head-on Condition between Patrol Boat and Standby Vessel

Figure 2 illustrated a schematic relation between reference vessel, a Patrol Boat when encounter in head-on situation. The course of target vessel keeps the distance in standby position axis 1500 meter and ordinate 1000 meter. Whilst, reference vessel, a Patrol Boat advances from axis 1500 meter and ordinate -1000 meter to 3000 meter. The KLF sets in position 100 meter form target vessel, reference vessel will be maneuvering in portside area, from ordinate position 987,3 meter. Then, the reference vessel gets stable maneuvering condition in 1203 meter.

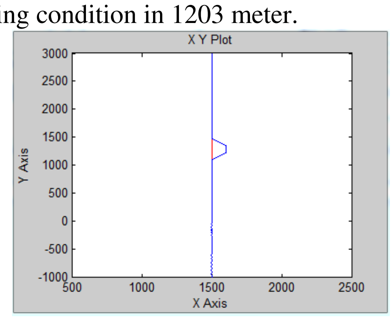

Figure 3. Head-on Condition between Patrol Boat and Advancing vessel

Figure 3 illustrated a schematic relation in difference condition. The target vessel starts to advance from axis 2000 meter to 500 meter. The advancing of target vessel will be influence the reference vessel to take maneuvering decision. Meanwhile from the opposite position, the Patrol Boat advances from ordinate -1000 meter to 3000 meter. In this research, the KLF sets in position 100 meter form target vessel length with speed less than 10 knot. Therefore, the reference vessel will be maneuvering in portside area, from ordinate position 1103 meter. Then, the reference vessel gets stable maneuvering condition in 1410 meter.

Results obtained in this study hence suggest that Fast Patrol Boat has steady maneuverability. Based on current research, it may be stated that mathematical model of Fast Patrol Boat in steady heading as heading desire. Thus, it influences its maneuvering for itself and avoids another vessel. However, more realistic simulation and free running experimental validation is suggested for future research. For example, consideration of different frequencies of waves, wind and other natural parameters may make the simulation model more pragmatic [3]

CONCLUSION

According to the research done, the following conclusion drawn:

1. The manoeuvrability of Fast Patrol Boat has been shown by simulation and numerical approach, that Fast Patrol Boat has steady heading of manuevering control.
2. The research results have shown that manoeuvrability of a Patrol Boat can be achieved in stable condition and avoid collision by minimum safe distance in more than 100 m and vessel speed less than 10 knots.

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