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VIETNAM WATERWAY TRANSPORTATION RESEARCH AND RECOMMENDATION OF ARPA AND AIS USED IN COLLISIONS AVOIDANCE

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Abstract. Vietnam is a country which have a long coastline, a dense river network and many waterway transportation vehicles which has increased very rapidly in recently years. Because of this, preventing collision at sea is a vital task. Currently, maritime shipping vehicles are provided modern technology equipments such as Automatic Radar Plotting Aid (ARPA), Automatic Identification System (AIS) already have given a significant assistance to watchkeepers in maintaining safety of navigation. Howerver, as a machinery, they also have available disadvantages that can cause an accident. The article will analyze the characteristics of this two devices and evaluate between their intimate relationship with the observance of Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGs-72). Accordingly, recommendations of ARPA and AIS used in collisions avoidance with sailing experience will shows to assist officer on watch cockpit, proposals of improve equipments with a top goal of safe navigation.

1. Vietnam Waterway transportation research

Vietnam is a country with a dense system of rivers and channels. It's forming an convenient network, correlate between different locals and regions in Vietnam. Vietnam inland waterways including rivers, canals, lagoons, lakes, bays, gulfs and along the coast, from the mainland to the island routes, routes connecting the islands of inland waters. The country has 3551 rivers and canals (3045 provincial and 406 inter-provincial) with about 80 577 km in length and 124 river gate, about 42,000 km are used for inland water transport, number of vehicles is about 276,000 (with AIS is 0.008%). Meanwhile, the rapidly increasing of the number of inland waterway vehicles leads to higher requirements for vehicle management and safety inland waterways [6, 8].

Table 1 Ships in Vietnam

Numble	type	quantity		Mechanical total power		Development capability	
		2014	2015	2014	2015	2014	2015
1	Total quantity	273727	276204				
2	Total load						
3	Cargo ship (ton)					13189820	13725959
4	Passenger (personal)					610878	616089
5	Total power			12044677	13350939		

Marine radar – ARPA has been used long time which serving for navigation at sea and collision avoidance. In addition, AIS which can identify other ships by their. In many cases, the information is broadcast from other ships in the area, and are also shown on the marine radar display so that the deck officers can see datas.

However, the number of collisions remains a big proportion, according to the survey of company Lloyd's of vessel accident in the period 2001 - 2012, the number of collisions for large vessels is 162, accounting for 10.4% [7]. For Vietnam, especially fishing vessels from 2014 to date,

the total number of fishing vessels in distress at sea is 3967 with 2,364 cases of people dead, missing, injured. Average annual statistics indicate that there were 60 accidents.

Table 2 Marine accident statistics in Vietnam

Accidents	Collisions	Drowning	Stranding	Fire board	Other Accidents
60	44	07	06	01	02

Specific as follows:

- Collisions including: Concerning in 18 Vietnam Ships, 17 foreign ships, 06 inland waterway vehicles and 03 fishing vessels; 13 cases occurred in the sea, 17 cases occurred within seaports and maritime channels; 09 accidents involved fishing vessels, 09 fishing boats being sank; 08 collisions and 02 collisions involving 03 military ships while in brigdge's area.
- Drowning: 07 cases (04 vessels and 04 inland waterway vehicles being sank in port waters.
- Stranding: 06 cases
- Fire board: 01 cases
- Other Accidents: 02 cases

In this: 14 cases of inland waterway vehicles occurs in port waters as 08 people dead or missing; 01 cases vessels derived from inland waterway ports and being sank, 05 people missing; 21 accidents related to navigation in the process of piloting the ship;

The accident with 22 people missing or dead and 25 waterway vehicles sunk, wrecked.

So far, theory researchs of ARPA and AIS in [1, 3, 4, 6, 7] provided for trainees and marine officers. However, in practical safe navigation, analysis and recommendations of this article below about using ARPA and AIS associated with compliance with COLREGs-72 (International regulations for Preventing Collisions at Sea, 1972) will help watchkeeper cockpit with synthetic vision, fully realized, make decisions and appropriate action in preventing Collisions at sea.

2. Recommendation of ARPA used in collisions avoidance

ARPA provides huge advantages in collisions avoiding and in all conditions of foresight because any risk of collision with other vessels in the journey always evaluated by computer technology and display results for maritime officers. It's achieved by marking and location tracing automatically [1]. This technology focuses on the fact that needed to determine the distance perigee (CPA - Closest Point of Approach) and perigee time (TCPA - Time to Closest Point of Approach) of the target vessel which to warning collision risks.

ARPA often provide a highly accurate results may appear on the screen in perfectly normal way without any attention unless Watchkeepers triggered an alarm functions CPA. In fact, CPA smaller than requirements maritime distance (such as standing orders or Captain command at night), but if it is a positive value, the maritime officers will tend to trying accept that value and the risk of collision does not exist.

The truth is that ARPA not smart enough to consider all relevant circumstances like too close situantion, and it can not assess all the elements which make a full risk assessment. ARPA also can not afford to consider these events might imminent, the weather conditions, the accuracy of the steering, safety incidents, traffic density, maritime situations. ARPA only know calculated on basis information which has undergone.

Before of the ARPA advent, in good weather conditions and normal traffic conditions, ship's officer based on boats watching direction which moving closer to determin risk of collision occurs or not. In the assessment of the time, the value of CPA is assumed by "0" or "small enough" depends on the speed of changing observed chronic angle. One advantage of this assessment is to check visually which demanding maritime officers more active for the transformation of situation. Watchkeepers do it to get guide of sightseeing and pay attention to any small changes as well as direction changing which to know collision risk exists or not . In the case of limited visibility, expeditionary officers must based on the value at the minimum CPA which has been installed under captain standing orders to confirm the risk of situations too close or not. Therefore, the Marine officer recommended following compliance processes as Watchkeeping cockpit as follows:

- Use eyes and compass on the reflections of the compass to determine the angle of ship's alongside and record this value;

- By looking lights cruise or column / crane to identify chronic angle and approximate other vessel's direction;

- By observing radar to determine distance to the other ship and approach speed.

In particular, absolute obedience Rule 19. Rule 19 of the COLREGs applies when in restricted visibility [5]:

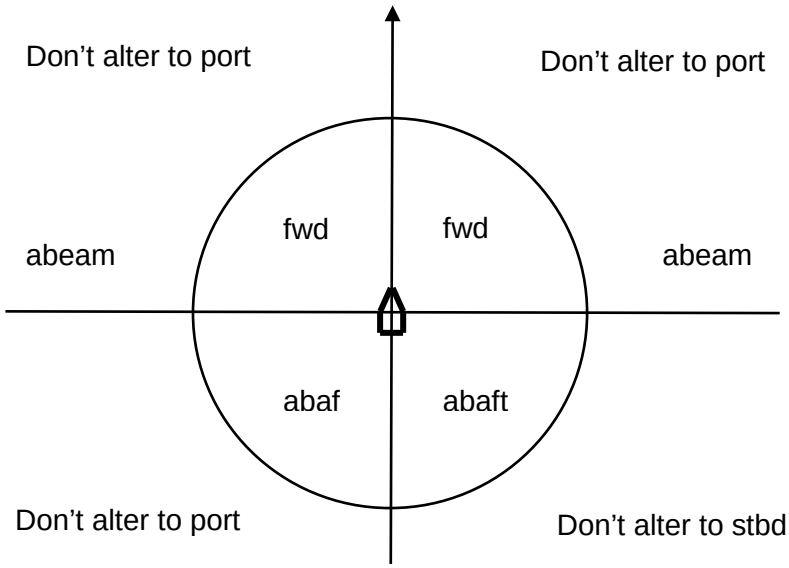
First, if detected another vessel by radar alone, take avoiding action in ample time provided, avoid the following as far as possible:

- An alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken;

- An alteration of course towards a vessel abeam or abaft the beam.

Second, except where it has been determined that a risk of collision does not exist, all of vessels which hears the another vessel's fog signal apparently forward of her beam, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall slow down her speed to the minimum at which she can be kept on her course, taking all her way off if necessary and in any event navigate's extreme caution until it's safe.

Fig. 1 Control ship in collisions avoidance



This process requires using directly senses in assessing situations are encountered. Currently this process still continuing being concern and must be used in right situation. For journeys of limited vision, radar observation, with the help of ARPA device, which requires officers perform shift early to promptly detect risks mechanical situations too close (close quarter situation) of the two vessels.

3. Recommendation of AIS used in collisions avoidance

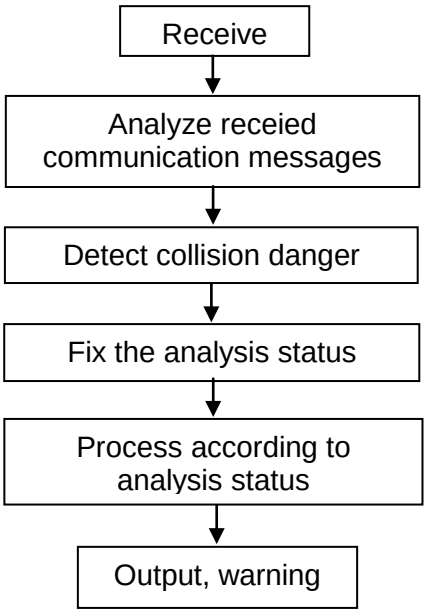
AIS display information on the cockpit. AIS provides identification ability for officers. Maritime (name, call sign and number MMSI) when the other vessel sailing near it. AIS operates on the VHF waves with effective range is about 30 NM. Data received including direction, speed, position and other vessels information. Since 2004, this equipment must be equipped on all ships which have more than 300 gross tonnage sailing on international voyages, cargo ships which have more than 500 gross tonnage sailing on non-international voyages, and all passenger ships which have same size. The biggest benefit which AIS information provide belong to shore stations, maritime ports, because this system allows identifying ports traffic and straits. This system is also invaluable assistance when making instructions of telegram traffic, warnings, and searching and rescuing.

Besides, benefit of AIS is ship surrounding's name can be displayed on ARPA's screen.

Theoretically, this is significantly assisted in vessel identification at early stage and officers can make decisions with better strategy. The fundamental issue is in fact, Can Improving target identification makes Collision avoidance becomes easier?

AIS operating methods are as follows:

Fig. 2 AIS operating methods



For the correlation between this ship with any other ship encountered, COLREGs-72 always be followed. Watchkeeping officers need to remember that no provision in COLREGs-72 allow to use AIS for ships information exchange with agreement. Consequently, many mariners are under the impression that AIS information SHOULD NOT be used for collision avoidance. Using AIS can lead to abuse VHF for collision avoidance agreement. If an officer has any doubt about time of using VHF to avoid a collision, instantly watch officers must check owner vessel journey is what kind of traffic area, how many watchkeepers's nationality in radar range scale; or owner vessel's name and other ship's name... In order to further understand this issue, one must go back to the original guidelines given by IMO on "Use of AIS in Collision Avoidance Situations". These guidelines are part of IMO Resolution A.917 (22), adopted on 29 November 2001. Those guidelines, incidentally, are set to be revised by IMO in 2014 [2].

Based on this analysis, in order to maximize the strengths of AIS in preventing collisions, watchkeepers should be taken following recommendations:

- AIS has similar status like ARPA and it should be viewed as an information display system to assessing the risk of collisions at sea. AIS information may be used to assist in collision avoidance decision making;
- Combine using ARPA with AIS and others to detect the risk of collision as soon as posible. the decision support tools are based on both AIS and ARPA information;
- AIS is not a device which encourage communication between the cockpit officer on watch; extreme caution while using AIS for supporting communication between ships;

4. Summary

Besides the advantages with strong support for the officer on watch cockpit, ARPA and AIS still are machines contain inherent disadvantages. The limitations of these devices need to be properly aware through training by ship's officer, knowledge and experience in the mining operation. Marine officers actually complete their shift when they hold in their hand everything which using for safely guide vessels, include ARPA and AIS. Finally, some sailing experience following are recommended for the officer on watch cockpit:

- COLREGs-72 provides rules for preventing collisions under all circumstances, so please understand and follow COLREGs-72;

- With COLREGs-72 the change of starboard corner is big enough to see with the naked eye or using radar [2]. It is important to remember that a direction changing less than 100 is not considered satisfactory by COLREGs-72 [3]. Based on the experience of skilled seafarers, values change direction at least 300 when the ship is sailing offshore [4, 5];

- Must understand what ARPA and AIS can and can not be provided. ARPA and AIS can not tell the officer on watch that there is no risk of collision / situations too close;

- Do not rely on only one device to maritime; using ARPA with any other method to determine risk of collision. If there is any doubt so risk must be seen as existing, and follow COLREGs -72;

- Proposed solutions to improving AIS system which being use to calculate the probability collision at sea, thereby warning to the duty officer;

- Always ready to use main machine - reduce speed or stop machine if necessary;

- Enhanced efficiency realm, always focused in shifts.

Collision Avoidance will, consequently, save lives at sea.

5. Acknowledgments

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