

Design of Mobile Ships Traffic Management Center Based on AIS Technology

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Abstract The waterway where traffic congestion and chaos happen is stochastic, so MSTMC(Mobile Ships Traffic Management Center) needs to be constructed on maritime supervision boat. MSTMC can be constructed via maritime supervision boat’s AIS ENC (Electronic Navigation Chart with AIS) receiving AIS (Automatic Identification System)’s standard information from supervised ships. MSTMC has two subsystems, one is ships traffic situation forecasting subsystem which is to scout and predict traffic condition in supervised water, the other is ships’ calling and commanding subsystem which is to identify and match and call and assign ships’ in supervised water. MSTMC accomplishes ships traffic management duty by the two subsystems.

Key words AIS; Ship trait identification; Navigation locomotion; Traffic management center; Traffic situation forecasting; Matching

1 Introduction

There are some studies about VTS (vessel traffic services), which mainly discuss stationary VTS matter. Recently, several scholars start to discuss mobile VTS problem. But theory or technique or function or intention about mobile VTS that scholars concern are different. This paper discusses mobile VTS by traffic situation forecasting subsystem and ships’ calling and commanding subsystem to solve traffic matter in stochastic water.

2 Idea to Design MSTMS

With ships transportation’s development, there are more and more traffic congestion and chaos which happen in water stochastically. Stationary ships traffic management center can’t answer for demand of traffic management in stochastic water, so MSTMC need be constructed.

Maritime supervision boat may arrive in stochastic congested and chaotic water and is equipped with AIS ENC, so MSTMC can be constructed via maritime supervision boat’ AIS ENC receiving supervised ships’ AIS information. MSTMC has two subsystems, one is ships traffic situation forecasting subsystem which is to scout and predict traffic condition via receiving supervised ships’ navigation locomotion information, another is ships’ calling and commanding subsystem which is to match and identify and call and command ships via receiving supervised ships’ trait identification information. MSTMC accomplishes ships traffic management duty by the two subsystems. The explanation is showed in Figure 1.

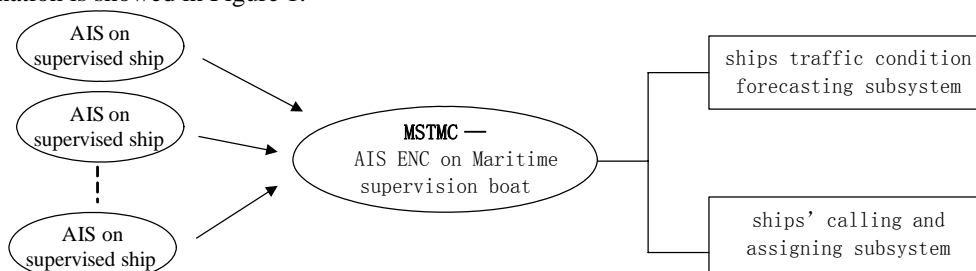


Figure 1 Idea to Design MSTMC

3 To Fulfill Subsystems of MSTMC

To mend AIS information’s format and function standard, ships traffic situation forecasting subsystem and ships’ calling and assigning subsystem in MSTMC on maritime supervision boat can be carried out by partial wireless AIS network in supervised water.

3.1 Idea to mend AIS information’s format and function standard

Current AIS are made up of transmitting and responding component and sensor and display. Its transmitting and responding component sends and receives ship’s trait and movement and voyage

information by VHF (Very high frequency) equipment. Its information isn't enough to fulfill ships traffic situation forecasting subsystem and ships' calling and assigning subsystem.

In order to carry out the two subsystems, AIS information's format and function standard must be mended according to demand. Mended AIS has two information modules, one is ship trait identification module, and the other is ship locomotion parameter module.

3.1.1 Ship trait identification module

Ship trait identification module includes:

- 1) Calling and identifying information, such as ship name, call sign, MMSI (maritime mobile service identity), standing by VHF channel.
- 2) Ship's trait identification information in daytime, such as ship category, ship shape, main deck trait, shell colour, bridge trait.
- 3) Ship's trait identification information in night, such as showing navigational light, assembling identification lights, temporary identification signal.

3.1.2 Ship locomotion parameter module

Ship locomotion parameter module includes:

- 1) Ship movement information, such as position, course off ground, and speed off ground.
 - 2) Reckoning track information, such as next waypoint, proximate track point at a regular interval between its position and next waypoint.
 - 3) Voyage information: destination, ETA (estimated time of arrival), crew, cargo stowage.
- Mended AIS information's format and function standard are showed in figure 2.

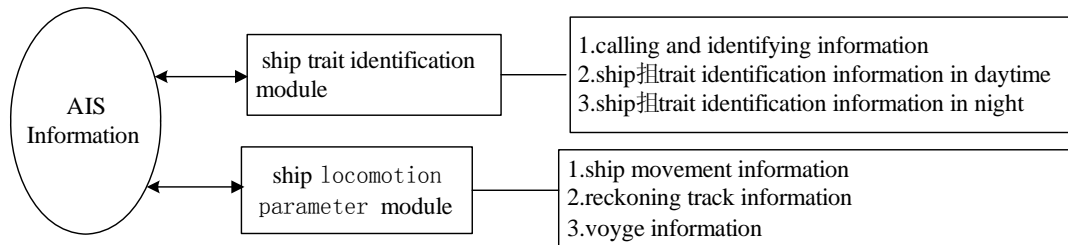


Figure 2 Idea to Mend AIS Information's Format and Function Standard

3.2 To fulfill ships' calling and commanding subsystem

To acquire traffic condition roundly and choose assigning ships which make jam in supervised ships, navigating by AIS and eyes synthetically is demanding and matching assigning ships found in eyes with assigning ships found in AIS is necessary.

So to fulfill ships' calling and commanding subsystem, Maritime supervisor firstly must match assigning ships which make jam found in eyes with assigning ships found in AIS, secondly must acquire assigning ships' MMSI or VHF channel stood by, finally may call and command assigning ship

The idea to fulfill ships' calling and commanding subsystem is shown in figure 3.

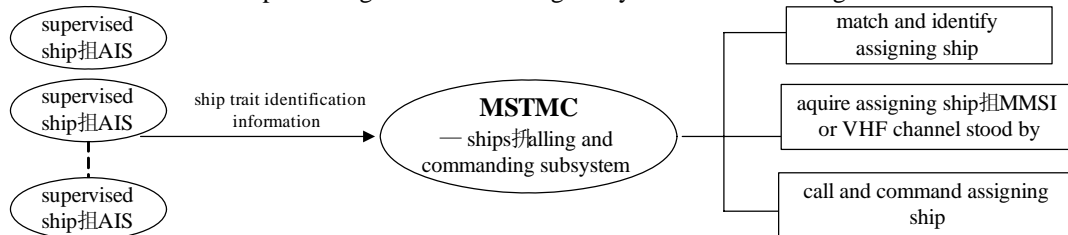


Figure 3 To Fulfill Ships' Calling and Commanding Subsystem

3.2.1 To match assigning ship

(1) Means to match assigning ship found in eyes with assigning ship found in AIS ENC in daytime

That all ships underway must input their trait identification information in daytime to AIS regularly is requested. Maritime supervisor can compare assigning ship's trait, such as ship shape and main deck trait and shell colour and bridge trait, found in eyes in daytime with assigning ship's trait in AIS information to match assigning ship which makes jam found in eyes in daytime with assigning ship found in AIS ENC.

(2) Means to match assigning ship found in eyes with assigning ship found in AIS ENC in night

Maritime supervisor can compare assigning ship's trait, such as showing navigational light and assembling identification lights and temporary identification signal, found in eyes in night with assigning ship's trait in AIS information to match assigning ship which makes jam found in eyes in night with assigning ship found in AIS ENC alike.

(3) Means to match assigning ship found in radar with assigning ship found in AIS ENC in fog

Maritime supervisor can look out at supervised water by radar and AIS in dense fog when looking out in eyes is defective. Connecting AIS signal to radar display can match assigning ship which makes jam found in radar with assigning ship found in AIS ENC in fog.

3.2.2 To acquire assigning ship's calling information

Maritime supervisor can acquire MMSI or standing by VHF channel of assigning ship by his AIS information after matching assigning ship found in eyes with assigning ship found in AIS

3.2.3 To call and command assigning ship

Maritime supervisor can call and command ships who make jam by VHF equip to ensure traffic order after acquiring their calling information.

3.3 To fulfill ships traffic situation forecasting subsystem

The function of ships traffic situation forecasting subsystem is to scout traffic condition in supervised water and forecast traffic situation later. The detail is shown in figure 4.

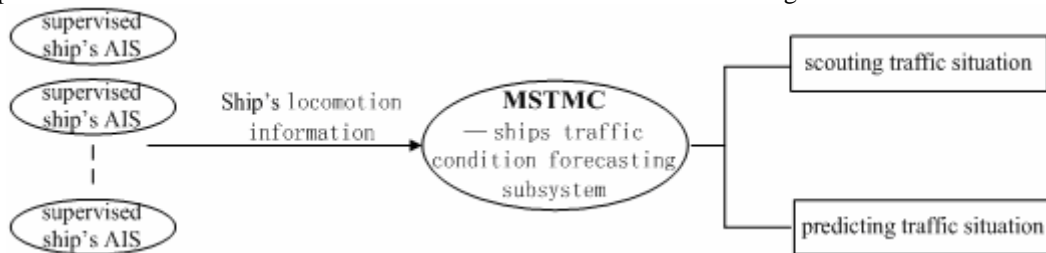


Figure 4 To Fulfill Ships Traffic Situation Forecasting Subsystem

3.3.1 To scout traffic condition

Supervised ships' position and speed and course information shown in maritime supervision boat' AIS ENC form traffic condition in supervised water. So maritime supervisor can scout traffic condition of the time by them.

3.3.2 To forecast traffic situation later

To forecast traffic situation, supervised ships' track and navigating time between its position and next waypoint must be reckoned. Maritime supervisor can forecast traffic situation at a special time by reckoning supervised ships' proximate track point at a regular interval between their position and next waypoint.

(1) To acquire information of supervised ship' next waypoint

Information of supervised ship' next waypoint can be acquired in supervised ship's AIS.

(2) To reckon supervised ship's track points at a standard interval between its position and next waypoint

Supervised ship's navigation time between its position and next waypoint can be reckoned according to distance of its position and next waypoint and speed and course. Supervised ship's track points at a standard interval between its position and next waypoint can be reckoned according to its navigation time and distance between its position and next waypoint. The explanation is showed in Figure 5.

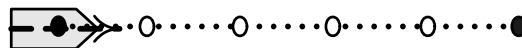


Figure 5 Supervised Ship's Track Points at a Standard Interval Between Its Position and Next Waypoint

(3) To forecast traffic situation at a special time

Supervised ship's proximate track point at a regular interval between its position and next waypoint can be selected in its track points at a standard interval between its position and next waypoint. All supervised ships' proximate track points at a regular interval between their positions and next waypoints form traffic situation at a special interval time. Traffic situation at arbitrary time can be forecasted by shifting track points' time interval. The explanation is showed in Figure 6.

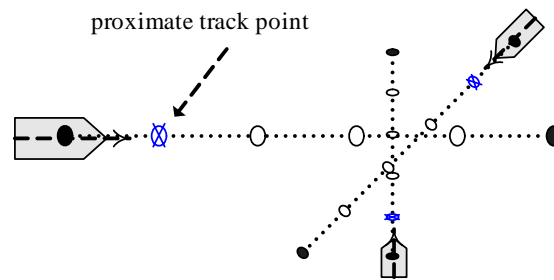


Figure 6 To Forecast Traffic Situation at a Special Time by Proximate Track Points

4 To Exert Traffic Management Effect in Stochastic Water

Duty of traffic management in stochastic water is that once traffic congestion and chaos happen, maritime supervision boat will arrive in the water and construct MSTMC and can identify and call and command assigning ships who make jam to ensure traffic order according to scouting and predicting traffic situation.

4.1 To acquire information of stochastic traffic congestion and chaos

Because waterway where traffic congestion and chaos happen is stochastic, information of traffic congestion and chaos mayn't be obtained by maritime supervision boat. Once stochastic traffic congestion and chaos happen, ships in the water must immediately report it to Maritime Safety Administration nearby. Maritime Safety Administration nearby informs maritime supervision boat to arrive at the water and construct MSTMC in this locale.

4.2 To scout and evaluate traffic situation in supervised water

When MSTMC has been constructed in this locale, maritime supervisor can scout and forecast traffic situation exactly by ships traffic situation forecasting subsystem of MSTMC combining with looking out in eyes.

4.3 To match and call and assign ships in supervised water

When find a ship disobeys order to make traffic jam, maritime supervisor can identify and match and call and assign the ship to ensure traffic order and waterway expedite.

5 Conclusions

To mend AIS information's format and function standard, MSTMC on maritime supervision boat can be constructed via receiving supervised ships' AIS information. Maritime supervisor can fulfill traffic management duty in stochastic water by ships traffic situation forecasting subsystem and ships' calling and commanding subsystem of MSTMC.

The following questions about information and capability and installing and using standard of AIS must be settled to carry out effect of MSTMS based on AIS technology.

(1) Information standard of AIS on all ships

Information standard of AIS on all ships must include: a) standard information of calling and identifying, b) standard information of identifying ship's trait in various circumstance, c) standard information of ship's movement parameter, d) standard information of ship's track points, e) standard information of ship's voyage, f) standard input of temporary information.

(2) Capability and installing and using standard of AIS on all ships

Capability and installing and using of AIS on all ships must include: a) standard power and distance, b) standard of restraining false signal, c) installing standard of universal ships, d) standard using of AIS on all ships.

References

- [1] Hong Deben. Navigation Equipment[M].Dalian: Dalian Maritime University Press, 2003 (In Chinese)
- [2] Wu Zhaolin, Zhu Jun. Traffic Engine at Sea[M]. Dalian:Dalian Maritime University Press, 2004 (In Chinese)
- [3] Du Changhe. Research on Mobile AIS Mathematical Model of Offshore Ships Management[D]. Qingdao Ocean University of China, 2009 (In Chinese)
- [4] Zhou Peng. Design and Research about Mobile VTS System Based on AIS[D]. Wuhan: Wuhan

- University of Technology, 2009 (In Chinese)
- [5] Eriksen Torkild. Maritime Traffic Monitoring Using a Space-based AIS Receiver[J]. Acta Astronautica, 2006,58(10):537-549