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An Overview of the Development and Application of AIS

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Abstract

Water transportation has a large volume and low cost, and is suitable for the transportation of bulk goods. It occupies an important position in the transportation industry. The complexity of the water transportation environment makes its safety face many problems. In order to improve the safety of ship navigation, relevant agencies and manufacturers have carried out various attempts. AIS was created based on this background. At present, AIS has been popularized all over the world and has become an important means of communication between ship and ship and between ship and shore. This article systematically introduces the composition, function and development of AIS, and provides a reference for the application of AIS.

Keywords

Water Transportation, Automatic Identification System(AIS), Ship Safety, Ship Collision Avoidance.

1. Introduction

The modern transportation methods mainly include railway, highway, waterway, aviation and pipeline transportation. Waterway transportation is a mode of transportation in which natural and artificial waters are used as routes and ships are used as vehicles [1]. It is mainly divided into ocean, coastal and inland rivers. Water transportation is still one of the most important modes of transportation in many countries in the world. In order to ensure the safety of waterway traffic and improve the efficiency of ship operations, technologies such as maritime radio, vessel traffic service (VTS), and automatic identification system (AIS) have emerged [2]. AIS is a digital navigation aid system composed of shore-based and ship-based equipment, which realizes the navigation status and ship information interaction between ships and ships and between ships and shore-based [3]. At present, AIS has been widely popularized and applied, providing a strong guarantee for protecting water traffic and ship navigation safety.

2. AIS System Composition

AIS system constitutes an automatic identification system (Automatic Identification System, AIS) is an open data transmission system composed of shore-based (base station) facilities and shipborne equipment, which can be connected to terminal equipment such as radar, VTS, and computer network training. Maritime traffic management and monitoring network.

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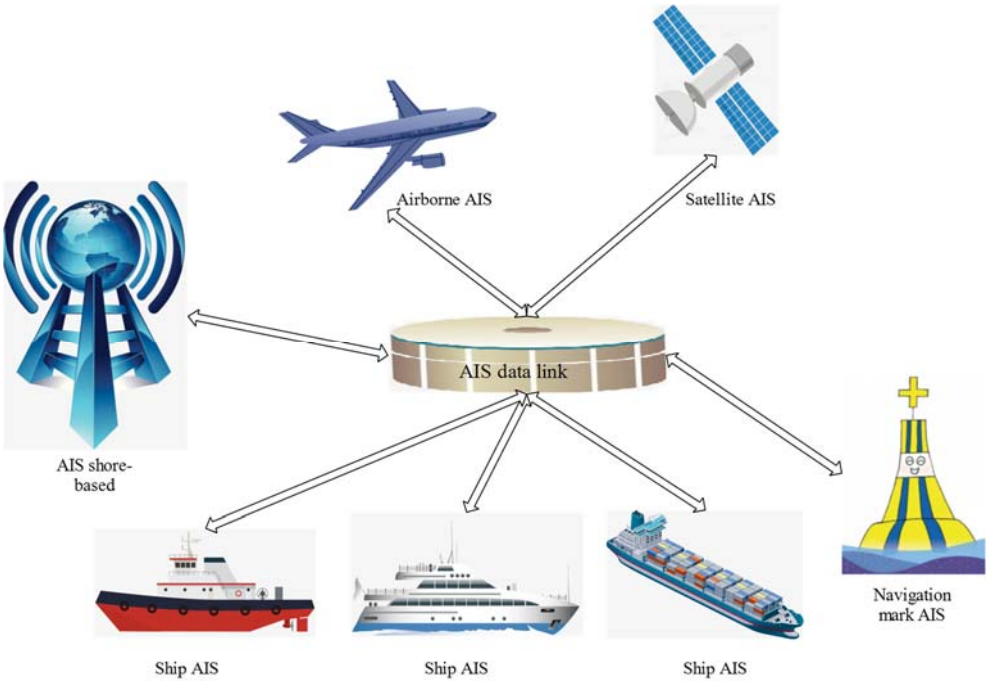

Figure 1. AIS system architecture

Shipborne AIS equipment is composed of information processor, interface circuit, display screen, VHF communication machine, etc., which can automatically exchange important information such as ship position, speed, course, ship name, and call sign.

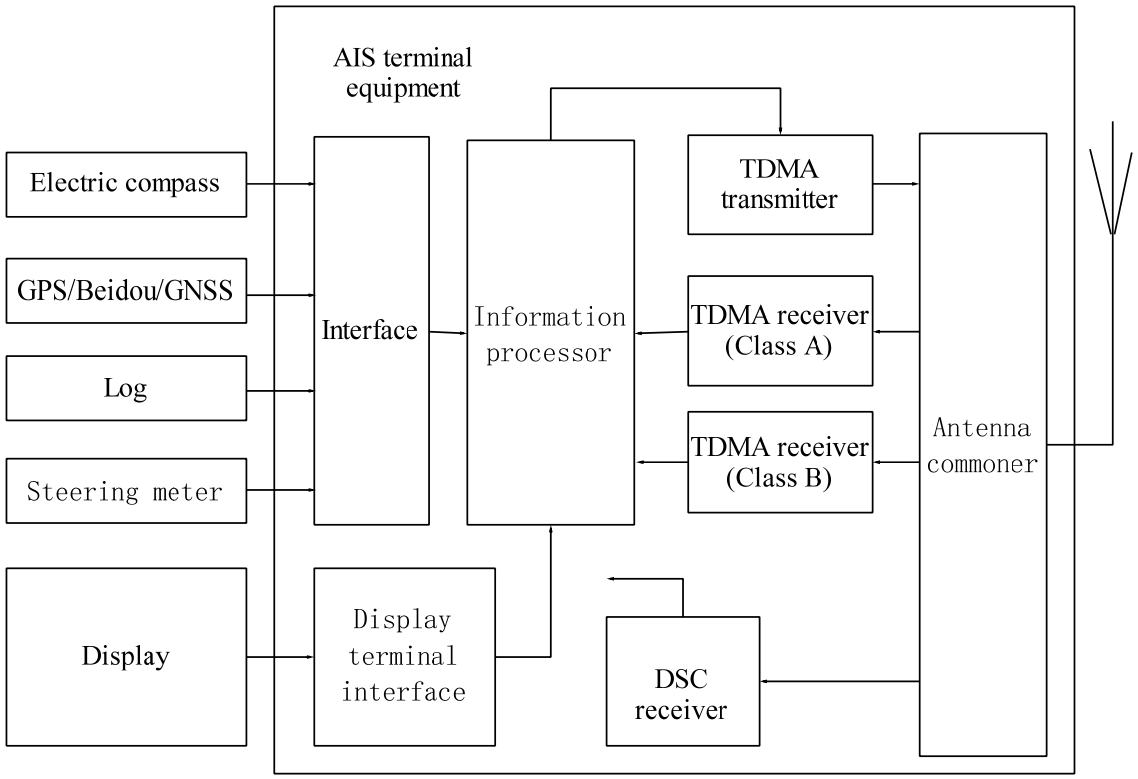

Figure 2. AIS device composition

The interface circuit receives the own ship's heading from the gyro compass, the own ship's ground speed and other signals from the log. The interface circuit receives the ship's position from GPS,

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BeiDou or GNSS receivers and UTC for synchronization time. The interface adopts RS232, RS485/422 standards. The information processor is the core component of the AIS system. It stores static information and navigation information of ships, receives navigation data from other ships, and decodes and stores them. Encode the ship's own static and dynamic data and send it to VHF for transmission. The VHF communicator includes a VHF transmitter, two VHF SOTDMA receivers and a VHF DSC receiver. Controlled by the information processor, it automatically transmits and receives the modulated signal specified in the protocol communication scheme. The display screen is used to display data and status information, and to monitor the operating conditions of the system.

3. AIS Functions

When a ship is installed with AIS, it can not only report navigation data to shore-based, but also exchange important navigation data with other ships. The maritime supervision department can obtain complete traffic dynamic information of all ships equipped with AIS and carry out monitoring and command. Ships can enter information about ships on regular voyages and fixed routes into AIS equipment, and AIS will become a ship reporting system. In addition, the use of AIS's SMS function can also avoid accidents caused by misunderstandings between ships due to inaccurate pronunciation. The main functions of AIS are as follows:

(1) Exchange of ship navigation information

Ships automatically provide navigation information to shore stations, other ships and aircraft, including ship MMSI, latitude and longitude, course, speed, ship name, ship call sign, etc. Automatically receive navigation information of other ships. Through the exchange of information, accessory ships can be identified.

(2) Guiding ships to sail

Pilots use AIS information to understand the navigation information of ships and nearby ships, and realize dispatch command, pilotage monitoring, and pilotage billing. In order to guide the ship to navigate the channel correctly, the maritime department will place beacons, buoys, and guide beacons on the route, and apply the AIS system to the beacons. The position information of the beacons will be reported to the ship, which helps to improve the safety of the ship’s navigation.

(3) Reduce ship collision avoidance

The emergence of radar technology has greatly reduced the probability of ship collisions, and it is the main equipment to assist ships in avoiding collisions. Because the radar is greatly affected by the weather, and there are blind spots. The fusion of radar and AIS can further reduce the occurrence of ship collision accidents, allowing ships to navigate more safely on the water.

4. The Development of AIS

In order to improve the safety of water traffic and navigation, the International Maritime Organization (IMO) and the maritime authorities of various countries have formulated and implemented various ship navigation safety rules, forced ships to install corresponding navigation aids, and established VTS, ship reporting systems, etc. Measures to manage the safe navigation of ships. Even if various safety measures are taken, ship collision accidents still occur from time to time. With the rapid development of digital communication technology, network technology and computer technology, relevant institutions and manufacturers have carried out continuous research and development on ship navigation aids, and finally produced the AIS system.

In the early days, communication between ships relied on VHF (Very high frequency) wireless phones, and language barriers made it difficult for both parties to communicate the ship’s operational intentions, which led to ship collisions. In response to this situation, some countries have begun to automatically obtain the ship's navigation status technology. In 1990, the United States developed a VHF automatic answering system (TRANSPNDER SYSTEM) based on VHF/DSC (Class D digital selective calling) technology. The basic idea is to automatically send out inquiry information in DSC

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mode. The ship's identification code, ship's name, ship's position, course, speed, draft and other information are automatically transmitted to the inquiring party, realizing the automatic response function. This is the first generation of AIS. 1 In 1995, Sweden and Finland first proposed the concept of radio AIS. At the IMO NAV41 meeting, they first proposed the application of self-organized time division multiple access technology (self-organized time division multiple access SOTDMA) to ship-to-ship and ship-to-shore maritime transponder systems. Suggested proposals. It is a time division multiple access algorithm with the ability to avoid and resolve communication conflicts, and is applied to mobile stations operating in autonomous and continuous mode. Compared with DSC, SOTMA increases the capacity of the system and increases the transmission rate, which is considered to be the second generation of AIS. In 1996, at the 42nd meeting of the IMO Navigational Safety Subcommittee, the draft performance standard of the "Automatic Identification System Device for Ships Using VHF DSC Technology" submitted by the technical group was reviewed, and the system was referred to as "AIS" for short. In 1997, the 43rd meeting of the IMO Navigation Safety Sub-Committee passed the "Proposal on the Performance Standards of the Global Shipborne Automatic Identification System (AIS)". The conference briefing described the function of AIS, which can complete the ship-to-ship model of collision avoidance, and the port state can obtain information about the ship and its cargo, as well as being a tool of VTS. In 1998, the 44th meeting of the IMO Navigation Safety Sub-Committee (IMO) recommended that all new ships and passenger ships over 300 gross tonnages must be equipped with AIS equipment from 2002.

Aiming at bottlenecks such as narrow channel bandwidth, limited communication distance, limited system capacity, and low transmission reliability of AIS, researchers have tried their best to improve system performance and make up for shortcomings under the existing AIS technical framework. The first is the improvement of the AIS protocol, such as adding a forwarding count to the message, improving the message type, and standardizing the physical layer parameters [4-5]. In order to meet the needs of long-distance ship monitoring, satellite AIS technology appears. Satellite AIS relies on the existing ship-borne AIS terminal, through the on-board high-sensitivity AIS signal detection and forwarding equipment, it detects and transmits the continuous and automatically transmitted AIS signal, which expands the data receiving range [6]. Developed countries such as the United States, Norway, and Japan have already begun satellite AIS technology research and have gradually developed their AIS satellite systems. The Tiantuo-1 remote sensing satellite launched in 2012, equipped with an AIS receiver, produced my country's first global ship AIS data chart. In 2017, China's first AIS commercial maritime satellite "Hede-1" was successfully launched. The satellite is equipped with an advanced AIS system that serves 60,000 ships per day.

5. Conclusion

The safety of water transportation is of great importance. Once an accident is sent, the consequences will be very serious. Ship safety is an important prerequisite for ensuring the safety of water traffic. Various countries and organizations have invested a lot of manpower and material resources to carry out research in this area, and AIS technology has emerged. At present, AIS has been widely used in water transportation and has become the main means of ship identification, monitoring and communication. AIS technology is also constantly being improved and will play a greater role in water traffic safety.

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