Analysis of Ship Traffic Flow in a Narrow Channel Using AIS Data

Xinjia GAO *, Masao FURUSHO **, Hidenari MAKINO ***

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1. Introduction
Research studies have analyzed the traffic flow and the actual situation of the navigation of vessels through Kurushima Strait, which is the most difficult narrow channel in the Seto Inland Sea. Vessel congestion and maritime accidents in this ocean area are frequent. Kurushima Strait's complex terrain and string currents make traveling through it even more dangerous, Kurushima Strait is especially dangerous for ship navigation, and many accidents, like collisions and groundings, can occur. Therefore, it is necessary to understand the actual navigational situation of vessels in this narrow channel to decrease maritime accidents.

In this study, Automatic Identification System (AIS) data was used to analyze the behavior of a ship group. So far, it has been difficult to understand the actual navigational condition of ships in ocean area units containing two or more ships. Particularly in this study, the behavior of ships that have actually cruised in a drifting situation under the influence of currents has been investigated in detail.

2. An Investigation of Vessel Traffic in Kurushima Strait
Kurushima Strait, the most important route not only in Japan, but also for connecting Japan with China and Korea, is always crowded with ship traffic. In this study a quantitative analysis of objective data was conducted in order to understand the traffic flow according to each day of the week and time period of ships passing through the Kurushima Strait route. During the investigation, 1427 passing ships were checked from March 1-7, 2012, and it was found that 58% of all Kurushima Strait traffic route passage ships are cargo ships. The other types of ships were tanker ship (30%), passenger liners (7%), and others (4%). Moreover, we elucidated the situation of ships passing through Kurushima Strait using AIS data. From the result of analysis, we confirmed that many vessels were cruising eastbound and westbound in this time zone at night, of which, many were passenger ships. Since Kurushima Strait has narrow waters and strong currents even during daytime, with difficult navigation, it is very dangerous for passenger ships, with many human lives at risk, to cruise at night.

3. Analysis of the Condition of Drifting Ship
This section describes the analysis result of the actual situation of navigational ships, which is affected by strong tidal current, using AIS data. It is customary maneuver for a ship operator to take the helm in order to resist external forces when a ship is drifting laterally. Generally speaking, the maximum permissible drifting angle to sailing is between 10 and 15 degrees, if this angle is exceeded, the original course of the ship will be significantly difficult to maintain. That is, when a navigational ship deviates to an angle exceeding 15 degrees, ship operators cannot control it, and this is an indication that the navigation of a ship is in a dangerous condition. Therefore, in this research, we paid attention to the abovementioned ship permissible drifting angle. Using the AIS data and a real navigation history of ships, the analysis results of the actual navigational situation confirm that, so far, many ships passing the Kurushima Strait route operate in the latent danger surpassing the usual recognition.

We calculate the drifting angle according to the course over ground (COG) and ship heading information stored in AIS data. The COG means that an operating ship heads on a true course under the influence of wind and tidal currents. In this study, a percentage of the number of sailing ships exceeded a drifting angle of 15 degrees on March 1, 2012. During the day, a total of 225 ships passed through the Kurushima Strait route, and 135 of them corresponding to approximately 60% of the total exceeded the maximum permissible deviation angle for sailing.

4. Conclusions
This research aims to help sea transportation by analyzing the actual situation of real navigational ships. This study proves that AIS data is a useful contribution to basic data in the field of maritime traffic. The main results of the detail analysis of the condition of ships are as follows;
1. The traffic flow in Kurushima Strait has been understood from a qualitatively perspective.
2. The situation of ships that have actually cruised in drifting situations has been investigated in detail.
3. Approximately 60% of all equipped ships exceeded a drifting angle of 15 degrees. Therefore, we found that most ships operate in a potentially dangerous mode when passing through Kurushima Strait.

References