Survey on Ship Autonomous Docking Methods: Current Status and Future Aspects

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ABSTRACT
In recent years, with the development of ships to large scale, it makes ship inertia greater, stopping performance and heading stability weaker, leading to poorer maneuverability of the ship. Computer technique, automatic control technology, and big data processing and analysis technology provide great support to the traditional control methods for docking control. Based on the ship-shore information interaction and the comparison of different control methods in the process of docking, this paper reviews the current status of research on previous studies, autonomous ship docking methods that can be used to control the ship on the given planned route are categorized. Finally, the characteristics of different ship docking are concluded, and future research prospects are given.

KEY WORDS: Intelligent ships; autonomous docking; motion control.

INTRODUCTION
Docking operation is the most difficult and complicated maneuver in the process of navigating, and it is an important evaluation content to test the technical level of the autonomous driving ability of intelligent ships in the future. The traditional docking includes identifying the proper anchorage and requiring pilot and tugboat before arrival with the shore control center, slowing down the speed when arriving, being operated by the captain or pilot, sailing in accordance with safe speed, entering the port via the channel, and relying on tugboats to assist in completing the docking if necessary. Final docking operation was completed synergistically by ship operator and terminal operator.

The propeller and rudder of a ship usually work in constant speeds, but docking practice, it will also be affected by water depth, ship speed, and bank. In practice, due to small inertia, more flexible, and auxiliary side pushing, small and medium-sized ships do not need the assistance of tugs, and the ships can dock depending on their own anchors and ships. However, it is difficult to dock large ships with their own docking equipment.

Large ships usually rely on tugboats to assist the docking operations. Under certain circumstances, they can also be independently docked by itself when the external conditions allow. Most maritime accidents are related to the adverse seamanship. Due to being unfamiliar with harbor environment, they mainly rely on cooperative operation of several tugboats to provide enough forces with the assistance of pilot to ensure the safety of navigation at present.

No matter the ship is controlled by the pilot or captain, he shall stop the engine and combine with the local wind direction, wind speed, water direction, water speed and size of the reverse power of the ship at that time, slow down and stop the ship in time according to the actual load.