Design of an Intelligent Trimaran USV for Maritime Rescue

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ABSTRACT

Human usually cannot work for maritime rescue at severe sea, so an intelligent trimaran USV (Unmanned Surface Vehicle) for maritime rescue is designed. Design works involve determination of ship type, intelligent navigation, intelligent collision avoidance, and intelligent control system. Firstly, trimaran is determined as ship type. Secondly, an integrated control system is designed, and then multitasking control platform of the USV is developed. Thirdly, multi-information fusion technology of multi-sensors of USV is developed. Fourthly, an algorithm of intelligent navigation and collision avoidance for USV is developed, and the technology of intelligent navigation and collision avoidance is achieved. Importantly, multimode heterogeneous network communication technology is applied for the communication between USV and base station. All technologies and equipments are applied and installed in a 5m USV and 7m trimaran USV to test the intelligent USV system for maritime rescue in a lake and river. Finally, the two model tests are used to verify the availability of equipments and systems, the systems of intelligent navigation and collision avoidance, and the system of intelligent control.

KEY WORDS: USV, Trimaran, Design, Maritime Rescue, Intelligence.

INTRODUCTION

A lot of researches of USV (Unmanned Surface Vehicle) have been performed by international institutes and companies, USV is becoming a hot research topic. USV is able to reduce the staff costs and improve the safety of navigation. Maritime accidents used to appear in severe ocean environment to lead to large number of casualties, it is a lot of possible to take a risk if manned surface vehicle goes to incident area where is dangerous for staff, and the efficiency of maritime rescue is rather inadequate. USV is a good choice to execute the task of maritime rescue at severe sea if unmanned advantage, high speed and availability of USV are obtained.

Bingham et al. (2011) multilayered the more tractable command and control architectures of unmanned vehicles, where decision-making, sensing, and actuation are separated so that the number of internal states of the system can be kept to a minimum. Huang et al. (2012) determined trimaran as ship type of USV, based on the kinetic equation for trimaran, the mathematical model is established according to the second-order Nomoto model, the simulation model of course control system is established, the fuzzy PID control algorithm is given.

Bertaska et al. (2013) implemented a tuned planner on the USV, where the dynamic response model of the controlled USV is used to generate dynamically feasible trajectories in real-time in response to navigational sensor inputs. Muljowidodo et al. (2013) proposed a design approach with the new propulsion system and control surface is featured in the present USV. the design and operation analysis of flying catamaran USV were presented. The design was focused on the propulsion and distribution of hydrodynamic and aerodynamic loads on the vehicle wherein computational fluid dynamics method was used as the main analysis tool.

Renzow et al. (2015) developed a conceptual design and automation aspects of an innovative ocean-going autonomously acting unmanned surface vehicle. As the vehicle act as communication node for deep-sea communication up to 6.000 meters, the main challenge is designing a low noise vehicle with reduced motions in waves. A hybrid energy system has been designed using batteries and a fuel cell. Fan et al. (2015) developed the technology of information network and control system for unmanned surface vehicles (USVs). By analyzing of the data and information which collected from various devices and sensors on the USV, a kind of the USV control system that can meet the needs of various tasks is designed.

In this paper, the design of trimaran USV for maritime rescue is discussed, a number of key technologies involving determination of ship type, intelligent control, intelligent navigation and collision avoidance, multimode heterogeneous network communication technology are grasped to realize unmanned navigation.

STUDY OF SHIP TYPE FOR TRIMARAN USV

Determination of ship type

Up to now, many USVs are designed and applied for various maritime