Development μ-ASV Using Surfboard

Yamato Kawamura¹, Tetsu Kato¹, Junichiro Tahara², Koike Masakazu², Shoichiro Baba³
¹ Tokyo University of Marine Science and Technology Graduated School of Marine Science and Technology, Tokyo, Japan
² Tokyo University of Marine Science and Technology, Tokyo, Japan
³ Japan Agency for Marine-Earth Science and Technology, Kanagawa, Japan

ABSTRACT

We developed a μ-ASV mounted on a surfboard for coastal surveys and routine tasks. We aimed for an ASV that can be transported by car though out in Japan by reducing the overall length to about 2m and weight to 45kg. Since the basics of this system were completed, we conducted a step response test in an actual marine area and analyzed. Then, we carried out a pool test using a μ-ASV implemented with automatic azimuth holding by sliding mode control.

KEY WORDS: sliding mode control; autonomous surface vehicle; system identification

INTRODUCTION

Currently, research on autonomous surface vehicles (ASVs) is being carried out actively. Many of them have been used in oceanographic research for seafloor topography surveys and as mother ships for AUVs. (Braginsky, 2020) However, ocean surveys using ASVs are mostly conducted in far offshore, and surveys of coastal areas have shown little progressed. In the future, seagrass beds and coastal surveys will be required for aquaculture in coastal areas. In fisheries where labor shortages have become a problem since the 2011 East Japan Earthquake, the μ-ASV can be used for unmanned monitoring of farming nets such as those for laver, oysters, and scallops, and the feeding of cultivated fish. We believe that the μ-ASV can be used for coastal fishery surveys as well as for sea desert and fishery resource surveys.

One of the reasons why the survey of coastal areas using ASVs is stagnant is that many ASVs are based on ships and cannot be used in shallow water. Therefore, we are developing a small ASV with a total length of about 2 m named μ-ASV based on the concept of developing a ship from a robot so that it can move safely even at a depth of 1 m or less. At present, as shown in Fig. 1, the development of the μ-ASV has been completed, and manual navigation can be performed using a PC connected via Wi-Fi. Automatic heading control is realized by adapting a sliding mode. We describe the electronic circuit configuration of the μ-ASV and the basic configuration of the control system, sensors (GPS/IMU), and wireless charger. Then, we analyze the results of the step input test performed in a marine area of Matsukawaura, Fukushima Prefecture. In addition, we describe the results of an experimental of automatically holding the orientation of the μ-ASV performed in a pool.

μ-ASV BASIC BODY DESIGN

Our μ-ASV is intended for use in shallow waters such as coastal areas, lakes, and ponds. For this reason, the size was set such that it could be transported in a one-box car when traveling within Japan. In addition, we decided to use commercially available parts with high versatility. We describe the configuration and system of the developed μ-ASV with these characteristics. The base hull is a buoyant surfboard with a length