

Development of the AUV/UROV “PICASSO”

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ABSTRACT

JAMSTEC pursues to develop a small hybrid vehicle for plankton investigation since 2005. The cutting-edge plankton survey system development project named Plankton Investigatory Collaborating Survey System Operon (PICASSO) project aims the establishment of a multiple vehicle observation scheme for efficient and innovative research of plankton. As the first step, we started the development of PICASSO-1 in April 2005. In last February assemble of the archetype vehicle system was completed and began sea trials. This vehicle equipped with high definition television camera is presently operated by UROV mode, which is the mode with thin optical fiber cable communication. The small vehicle was tested using various classes of support ship; Yokosuka (4,439 tons) and Natsushima (1,739 tons) owed by JAMSTEC, and Rinkai-maru (17 tons) owed by University of Tokyo. Sea trials carried out with either ship are successfully finished and could obtain a lot of images. The vehicle mounted underwater microscope was also tested and gathered photos of a few milli-meters planktons. In the latest sea trial a newly developed stereoscopic high definition TV system was tested to make 3-D underwater presentation film and to estimate object scale. We are currently processing data obtained. We have also tried to develop plankton autonomous tracker. For making it come true, it is necessary to investigate two technologies that are plankton recognition and autonomous vehicle body maneuvering. For the former, we intended to take the recognition technique developed in MBARI. For the latter, we have measured real dynamics of the PICASSO-1 vehicle, preparing kinematics model of the vehicle. We want to operate the vehicle with the autonomous mode by the end of next fiscal year.

KEY WORDS: Untethered ROV; Autonomous underwater vehicle; Plankton; Underwater high definition camera; Visual plankton recorder; Three dimension HDTV camera system.

INTRODUCTION

It is important to investigate ecological chain and transportation of carbon in underwater. Phytoplankton photosynthesize on sea surface

and zooplankton predaceous them. Investigation of plankton must be needed because plankton is the largest quantitative life in underwater. Several trials with ROVs and manned submersible (Wiebe and Benfield, 2003) have been carried out to investigate the distributions of macro- and micro-plankton versus environmental parameters. In this way, one is only able to gain the information of a point nature and not be able to determine large-scale distributional patterns with limited ship-time. Both winch-controlled towed systems (MOCNESS net, BIONESS net, BIOMAPER-II system) have been equipped with a combination of imaging, acoustic and environmental parameter sensors. However, the maximum operation depth for the BIOMAPER-II and SeaSoar were only 300 m and none of these systems had imaging systems of high enough resolution to identify and quantify plankton at the species level (Wiebe and Benfield, 2003).

Since 2005, JAMSTEC has development and construction of a multiple-platform autonomous survey system able to quantitatively characterize the midwater environment, including fragile components such as large particulates and gelatinous plankton. This system could be deployable from small to medium sized boats and ships. The first vehicle of the system are based the small hybrid underwater vehicle (UROV/AUV), MROV (Yoshida, Tsukioka, Hyakudome, Ishibashi, and Kitamura, 2005) developed by JAMSTEC and are equipped with a high-resolution camera system, a Visual Plankton Recorder and environmental sensors. The survey system will work in concert; will overcome all of these previous shortcomings. The use of JAMSTEC's 1.5m² IONESS net and an ROV or HOV with specimen sampling capabilities will enable calibration and ground-truthing of the data collected by the vehicle system.

In this paper, we introduce the system configuration of the survey system and mention detail of the major imaging devices. Some topics in three times sea trials are presented and then future development plan is described.

SYSTEM CONFIGURATION

The PICASSO system consists of a vehicle, an on-board controller, an operation console, a vehicle positioning system, and a battery charger. The major goal of the PICASSO project is the achievement of plankton