Small hybrid vehicles for jellyfishes survey in midwater

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ABSTRACT

Two hybrid underwater vehicles for use in shallow-water to mid-depth zones have been designed for biological and oceanographic observations at depths of up to 1,000 m. These small, light vehicles can be handled and operated by a team of only a few people. The low-priced, easy-to-use vehicles do not need a dedicated support ship. Both vehicles can be used either as untethered remotely operated vehicle (UROV) or autonomous underwater vehicle (AUV). In UROV mode, the vehicle is connected with an on-board controller via a thin optical fiber cable so that real time observations can be done. We expected that the UROV mode is mainly used for observations in the sea, because scientists want to observe underwater images and data in real time, and then choose observation targets.

One of the vehicle named "MROV" has been iteratively tested in the sea since 2005. The MROV (1.4 x 0.7 x 0.4 m, 80 kg) is equipped with a NTSC TV camera, a side scan sonar, a Doppler velocity log, a compass, an attitude sensor, a depth meter, a GPS, and an ARGOS transmitter. The MROV has been retrofitted with an auto video plankton recorder (VPR). The other vehicle named "PICASSO" is under development. PICASSO (2.1 x 0.8 x 0.8 m, 200 kg) is slightly larger than MROV. This multifunction vehicle is equipped with four NTSC cameras, a CTD-DO, a turbidity/fluorescence sensor, and a MEMS gyro as well as the devices equipped in the MROV. PICASSO can be also equipped with any of the following devices: a HDTV camera, a high resolution, a 12-bit color digital CCD camera, an auto VPR, or a 400 W HID lamp.

The vehicle assembly was completed. We plan sea trials in February and April 2007: 1) the first diving test of PICASSO, 2) observation of jellyfish, 3) test of multiple vehicle deployment, and 4) semi-automatic jellyfish tracking.

KEY WORDS: AUV, UROV, small underwater vehicle, midwater zone, jellyfish, video plankton recorder.

INTRODUCTION

Several trials with ROVs (ROV JASON, Phantom IV ROV, MAXRover ROV) and manned submersible (DSRV Johnson Sea-Link) (Wiebe and Benfield, 2003) have been carried out to investigate the distributions of macro- and micro-plankton versus environmental parameters. In these way, one be only able to gain the information of a point nature and not be able to determined 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). There is an useful plankton determination tool, the Visual Plankton Recorder (VPR). This is an underwater video microscope system that that takes images of plankton and particulate matter as small as 50 microns and up to a few centimeters in size. All VPR deployment to date have been shallower than 500m, have used monochrome cameras, and have not been quantitative with regards to marine snow data.

In 2005, JAMSTEC started design, 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, but be deployable from small to medium sized boats and ships of opportunity. Vehicles 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 VPR and environmental sensors. The survey system consist of the multiple small underwater vehicles with a 1000m depth rating, working 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 detail of the vehicle design. Some previous test results for design the vehicle. Future plans of development of the system and surveillance are given. Sea-trial report will be presented in the conference because no trial is carried out at writing this paper.