Jury's Special Award

Offshore and underwater robot systems that make a mothership-less seafloor survey system possible

Team KUROSHIO

Japan Agency for Marine-Earth Science and Technology; Institute of Industrial Science, University of Tokyo; Kyushu Institute of Technology; National Institute of Maritime+ Port and Aviation Technology; Mitsui E&S Shipbuilding; Nippon Marine Enterprises; KDDI Research, and Yamaha Motor

Bringing together technology from eight institutions from industry, academia, and government. Ranked number two in the world

■Outline

Typically, uderwater robots used for seafloor surveys are transported and deployed to the sea by a manned support vessel and controlled by acoustic communication from the vessel. In order to further expand the use of underwater robots, Team KUROSHIO developed a mothership-less seafloor survey system which enables surveying of the seafloor using only robots without using a mothership. The system consists of an Autonomous Surface Vehicle (ASV), multiple Autonomous Underwater Vehicles (AUV), and a land-based station, and the operator remotely monitors and controls the ASV and AUV via satellite communications.

■Features of the system

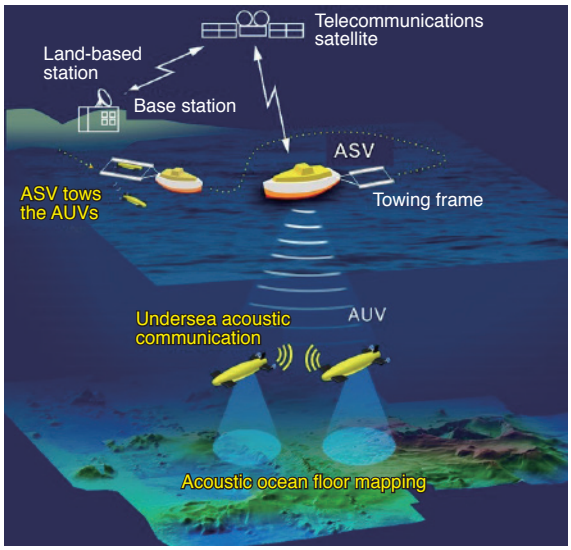
As the system has no mothership, in order to transport and deploy AUVs using the ASV, a towing frame was developed that can be customized to suit the AUVs to be transported. The towing frame is a buoyant body equipped with a mechanism to hold AUVs at two points and can transport AUVs of various shapes while cooling them with seawater. The AUVs and ASV can communicate wirelessly during transportation, and when the AUVs are detached from the towing frame, they will automatically start diving and surveying.

In this system, the ASV is equipped with a satellite communication device and an underwater communication device that can be used to remotely control an AUV even after it is submerged. The AUVs and ASV are guided so that the AUV is always within a certain range directly under the ASV so that they can stay within communication range. In underwater acoustic communication, it may not get through depending on the environment, so a new underwater acoustic message communication technology was developed to enhance communication stability by transferring communication from the AUV that receives the message, to other AUVs.

■Achievements and developments

The Shell Ocean Discovery XPRIZE, the first-ever international competition for unmanned underwater research, held from 2016 to 2019, of the 32 entries from around the world, Team KUROSHIO was the only team from Asia to compete in the finals held in December 2018 off the coast of Greece on the seafloor of the Mediterranean. The AUV towed by the ASV was detached offshore, and spent over 23 hours conducting seafloor research. 30km offshore from the port, in water about 1,000m deep, the survey succeeded in producing a topographic map of the seafloor covering an area of 5km by 33.5km. As a result of the evaluation by the judging panel, Team KUROSHIO was awarded second place (The Grand Prize Runner-Up). This achievement demonstrated to the world the high level of Japan's marine robotics technology and was widely reported in Japan and abroad.

This system developed by Team KUROSHIO has the potential to respond to national-level issues such as seafloor topography surveys, but also to private sector needs such as searching for lost objects, and installing and maintaining equipment installed offshore, under the sea, or on the seafloor, such as submarine cables, offshore wind power generation facilities, and more.



Concept illustration of the offshore and undersea robot system

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