

Autonomous Underwater Vehicle for Water Environment Monitoring

Purpose:

The main objects of physical and chemical measurements of coast, lakes and rivers have so far been water environment and water resource issues. However, the demand for these measurements has expanded to CCS and HLW disposal, etc. recently, and the costs and time of water environment surveys are increasing because three dimensional mapping over wide areas is required to make these environmental measurements. Therefore, CRIEPI has introduced the AUV to efficiently obtain three dimensional distributions of water quality, flow velocity and topography by autonomous sailing along the coast and in lakes, rivers and dams.

Outlines:

Chemical and physical environments of the sea and lakes are measured by using the ROV (Remotely Operated Vehicle) in general. However, wide-ranging mapping works by the ROV require much time and are limited by climate and ocean conditions. On the other hand, this equipment, which is named AUV (Autonomous Underwater Vehicle), is able to operate at an equal altitude or an equal depth autonomously regardless of the climate and ocean conditions. CRIEPI has installed many kinds of chemical sensors such as a "Nose" in this AUV to specialize in the water environmental survey. In these sensors, the ISFET-based pH, ORP and pCO₂ sensors developed by CRIEPI are especially suitable for measurement using underwater vehicles because of their high resolution and fast response.

In addition, the CRIEPI's AUV is also equipped with ADCP (Acoustic Doppler Current Profiler) for measurements of the current direction and the velocity, and with side scanning sonar as an "eye." The general sidescan sonar is usually towed from a surface vessel. We can obtain more precise topographic images than by towing the sidescan sonar since the CRIEPI's AUV can approach to within a few meters from the bottom of the sea or a lake and can retain this depth while navigating.

- 1) To survey various water environments such as the distribution of turbid water, chemical composition of water, and the distribution of phytoplankton along the coast and in lakes, dams and rivers.
- 2) To map the CO₂ leakage and the groundwater seepage from the sea bottom as natural analog studies involved with CCS (carbon dioxide capture and storage) and HLW (high level radioactive waste) disposal.

Specifications:

(1) AUV

- ① Weight (in Air) : 45Kg
- ② Maximum Operating depth: 100 m
- ③ Endurance: 22 hours at optimum speed of 1.5 m/s
8 hours at optimum speed of 2.6 m/s
- ④ Navigation: Hybrid navigation combining LBL and dead reckoning (by DVL and/or GPS)
- ⑤ Communication: Micro-Modem (ACOMS at underwater) and iridium (satellite telephone on surface)

(2) Sensors and objects

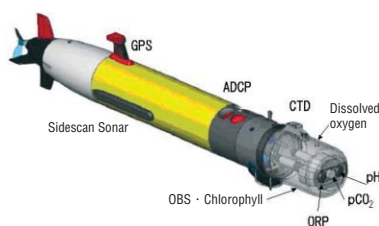
- ① Sidescan Sonar: Submarine topography
- ② pH: Hydrogen potential
- ③ ORP: Oxidation-reduction potential
- ④ O₂: Dissolved oxygen
- ⑤ pCO₂: Dissolved carbon dioxide
- ⑥ OBS: Turbidity
- ⑦ ADCP: Current direction and velocity
- ⑧ CT: Conductivity and temperature
- ⑨ Chlorophyll: Phytoplankton

Location and Date of Installation:

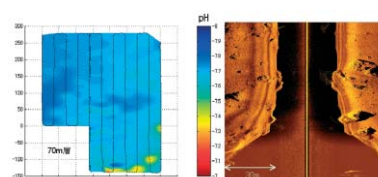
Abiko Area, March 2008



CRIEPI's AUV



Sensors equipped in AUV



Distribution of pH (left) and acoustic images by sidescan sonar (right)