AUVs Provide New Dimension to Sea Floor Mapping

Autonomous underwater vehicles (AUVs) are opening new dimensions to sea floor mapping, providing unprecedented accuracy in deep water as well as the potential to conduct engineering inspections and mapping of time-dependent processes.<P>

AUVs are becoming an increasingly important tool for mapping the sea floor, with over 20 full-function (including swath bathymetry, side-scan sonar and sub-bottom profilers) vehicles in operation or final stages of development around the world. These systems typically operate near the sea floor, at altitudes of 30 to 50 metres, providing bathymetry that is accurate to a few tens of centimetres. The primary limitation to the accuracy of deep-water AUV surveys is the accuracy of vehicle navigation, which is constantly improving with better inertial navigation systems and advances in the use of control positions based on USBL (surface vessel) or LBL (bottom transponder) systems. The overall accuracy of deep-water AUV measurements is primarily a function of navigational accuracy.

At present, the driving market for AUVs is deep-water oil and gas development. As deep-water production is pushing into water depths approaching 3,000 metres, the only way to provide engineering maps with the accuracy and resolution needed for installing and maintaining pipelines and other infrastructure is by measuring close to the sea floor using AUVs or tethered remotely operated vehicles (ROVs). AUVs are now more cost-effective than ROVs. Expenditures for deep-water oil and gas are expected to increase greatly over the next few years.

In addition to the booming deep-water oil and gas market, there are emerging requirements for high-resolution mapping for other types of pipes, as well as for installation of ocean energy devices such as bottom-mounted turbines. These ocean energy devices will be installed in high-energy environments that would normally be avoided, so will probably also need follow-up high-resolution surveys. Electrical power cables, which have very large bending radii and thermal constraints requiring careful installation, will also require high-resolution surveys requiring AUVs in water depths greater than about 300 metres.

As AUV technology develops, new capabilities will be added. These will include optical sensors and image recognition that will be used for inspection of existing structures such as submarine cables, as well as sensors and sampling devices to monitor the water and even sample the seabed.

A particularly interesting future application of AUV technology will be the deployment of submerged mooring systems where AUVs will be docked over long periods of time, generally as part of scientific ocean observatory systems. This will truly add a fourth dimension – time – to seabed mapping. The docked AUV can be given a mission and commanded to, as an example, map a newly erupting hydrothermal vent, then return to the docking station, download the data, charge its batteries and wait for the next mission. Given the precision of AUV mapping, these systems can even be used to monitor crustal deformation in seismogenic regions such as the thrust zones offshore Japan and similarly active areas.