AUVs: A New Beginning

This issue of Hydro international clearly demonstrates the level of effort and anticipation that is presently going into the development of Autonomous Underwater Vehicles (AUVs) for offshore marine surveys. These complex and versatile vehicles will provide a new level of high-resolution deep-ocean mapping, initially most valuable for deepwater engineering surveys and for scientific studies.

Even the best sounding techniques are limited by simple physics. In 500 metres water depth, for instance, the best hull-mounted multi-beam echosounder may be expected to provide soundings that are accurate to a few meters and that represent the acoustic return from around 75 metres of seabed. Yet a cable plough can tumble over unexpected 20Â¡ slopes that are only as large as the footprint of the plough Ã a few metres. Similar small-scale relief is significant for pipeline suspensions, and for placement of any structure on the seabed.
To provide high-resolution mapping data in deep water we have previously relied on deep-towed sonar systems. These can be designed to operate at low altitudes above the seafloor, so can maintain shallow water bathymetric resolution down to their full operating depths. In practice, this means that a typical deep cable or pipeline installation can rely on one-metre bathymetry to thousands of metres of water depth. But these deep-towed systems have two significant limitations. First, since they are towed on a very long cable, a long time is needed to make the large turns required of many survey patterns. And second, depending on the towing configuration they have to fly at sufficient altitude to avoid crashing into the seabed due to unexpected relief or some variation in tow vessel movement.
Although there is considerable comfort in having expensive equipment secured to the surface vessel by a steel cable, AUVs can now eliminate the major problems of towed systems by their ability to turn very quickly and to easily adjust and maintain fixed altitude above the seafloor.
A full AUV kit, including the support vessel, presently carries a daily cost that is two to three times the cost of a vessel equipped with a hull-mounted swath bathymetric system or with deep-towed swath bathymetric side-scan sonar and sub-bottom profiling equipment. This cost differential may be quickly recovered if the survey requires many turns. For example, during a high-resolution survey of a 4 x 4-kilometre block in 1,000 metres water depth a towed system may be expected to spend three hours making turns for every hour of surveying in the block. For smaller or more complex survey patterns the ratios worsen, while an AUV could complete all the work with almost no expensive turn time. On the other hand, for long and skinny surveys (such as cable or pipeline routes) where there are few turns, an AUV is very expensive.
AUVs also have tremendous potential for scientific research. A recently completed engineering feasibility study demonstrated that an appropriately equipped AUV, cruising within 15 metres of the seafloor and navigated relative to very precise acoustic bottom reference stations developed in Japan, should be able to map large areas to decimetre accuracy in full ocean depths. These ultra-high resolution surveys could be used to measure seabed deformation related to earthquake strain and seismic release.
We will see many applications for AUVs, particularly as one-time development costs are amortised and new technologies, including more efficient batteries and fuel cells, are developed. Precise bathymetric surveys are making another leap: forward and downward to full ocean depths.

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