MAPPING THE DEPTHS

AUTONOMOUS VESSELS, BOTH SURFACE AND UNDERWATER, ARE CHANGING THE SPEED, DETAIL AND SCOPE OF HYDROGRAPHIC SURVEYS. **RICHARD MILLS** REPORTS

Surveying the seabed has traditionally been carried out from the surface. Early hydrographers used spot soundings, measured with a lead line and located using a sextant or, close inshore, triangulation from land topography. Wire drag techniques, whereby a wire catenary is dragged along the seabed by two ships, became popular during the first half of the 20th century to survey more complex coastal areas. But it was the advent of sonar and GPS which revolutionised the science of hydrography.

Echosounders capable of measuring a single spot depth first came into use in the 1920s and were quickly adopted by survey vessels as a simpler way to achieve the results hitherto obtained using a lead line. Wire drag methods persisted for longer as the only way to survey large areas for obstructions and wrecks. But the advent of multi-beam and sidescan sonar systems finally made methodologies relying on physical contact obsolete.

However, something none of these methods ever solved is how to accurately survey the seabed at depths greater than about 40m, which is too deep to accurately place a leadline and sonar signals are hopelessly attenuated by the depth of water. With pipes and cables criss-crossing our oceans and oil and

data being shared on a global basis, we have never been so dependent on the quality of our subsea surveys to deliver safety through precise geolocation.

Another strategy is therefore needed.

Getting closer

With today's technology, the only viable solution to the problem is to use the same sonar scanners that deliver such good results in shallower water, transported to a depth at which they can operate. The quality and resolution of their output is not in question – so why not find a way to get them within 40m of the bottom?

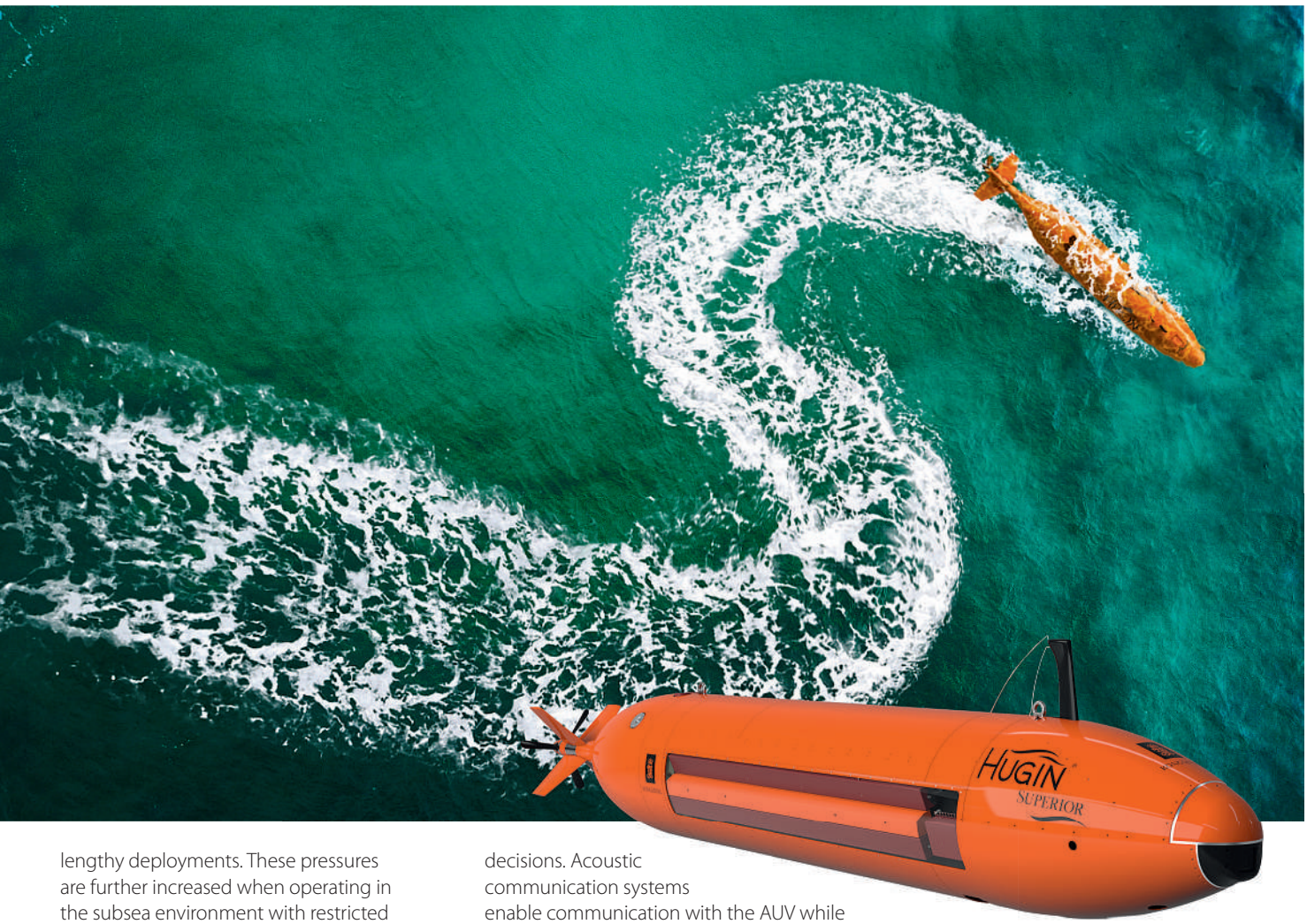
Fortunately, modern submersible vehicles are more than up to the job. Remotely operated underwater vehicles (ROVs) are now routinely used for a range of applications, from environmental conservation to cable laying. Hydrography is no exception. Putting the sounders in an ROV and taking them closer to the seabed makes sense, but they are still restricted by the tether, leaving a surface vessel to follow the ROV's evolutions far below and log the data it gathers.

But what if that tether could be cut? What if the ROV became an AUV – an autonomous underwater vehicle, capable of carrying out most of the survey without significant intervention from the surface?

That's the approach Kongsberg Maritime is using in an application of its HUGIN AUV. Designed as a platform for a range of applications including pipeline inspection and mine reconnaissance, the HUGIN allows sonar systems to be taken to depths of up to 6km.

Widening the scope

It's useful to complete surface surveys as quickly as possible, because of restricted weather windows and the cost of lengthy



lengthy deployments. These pressures are further increased when operating in the subsea environment with restricted dive times. It's therefore essential to make best use of the time underwater.

Fortunately, multi-beam and sidescan sonar technology have been making great advances in recent years with the effect that the HISAS 1032 Dual-Receiver Synthetic Aperture Sonar, for example, can scan up to 500m either side of a vessel compared.

Extended dive times are also essential for efficient operation at these depths – with typical descent and ascent speeds at around 20 minutes per 1,000m, a dive to 6km takes around two hours. Allowing for a two-hour on-deck turnaround with a surface support vessel to change batteries, an AUV can be gathering data for 92% of its 80-hour endurance time, even when operating at extreme depths. This, teamed with the wide survey swath, gives an impressive coverage of around 4.5km2 per hour.

Keeping in touch

AUVs can be pre-programmed to follow a pattern to ensure a complete survey of athe designated area. However, as they are exploring areas that have never been surveyed, there is always the chance that a subsea feature may be encountered that demands a change of the plan.

To deal with this, a surface vessel can be used to track the AUV and transmit policy decisions. Acoustic communication systems enable communication with the AUV while it is underwater, relaying data to and from the surface at up to 8kbit/s. This link can be used to forward the survey data in real time or simply to carry operator commands.

But what if multiple AUVs are deployed to survey a larger area? Tracking each device with a manned surface ship seems inefficient when a single vessel would suffice for data collation, operational decisions and battery changes.

Kongsberg's solution is the Sounder unmanned surface vessel (USV). This can track an AUV and be used as a communications relay vessel, potentially allowing a single, manned 'mother ship' to control several HUGIN/Sounder pairs. Alternatively (or additionally), it can be fitted with a range of sensor options to facilitate autonomous survey in shallower water up to 40m. It comes fitted with a broadband radio permitting two-way data transfer at ranges up to 50km and can use Iridium satellite for longer distances. A VSAT terminal may be fitted if higher data rates are required or if operating out of the MBR's range.

Tailored data

The Sounder USV processes survey data in near real time and is sufficiently intelligent to know whether it or the AUV it is shadowing is completing its objectives. If local circumstances prevent it from doing so, the decision to alter the plan lies with the remote operator. However, as regulations develop, the USV is likely to be able to autonomously alter its own mission and that of any associated AUV. This will be particularly useful in optimising coverage, ensuring minimal overlap between scans and allowing the vessel to autonomously locate and fill any gaps in the survey on the fly.

As autonomous survey techniques become more commonplace, vessels such as these are likely to become the norm. Capable of autonomous operation for long periods, well beyond visual line of sight, USVs can be used for independent coastal and harbour surveys right through to teaming up with AUVs for underwater search and mapping work. Autonomous, high-resolution surveys carried out by AUVs and USVs have the potential to provide incredibly detailed information about areas which may hitherto never have been surveyed, revealing the secrets of the seabed and enabling subsea technologies to be implemented and maintained in more efficient and environmentally aware ways than ever before.

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