Imagine robots that patrol beneath port waters, able not just to notice and then identify security threats, but also able to keep tabs on water pollution, silting up of vulnerable areas and inspect the integrity of underwater assets.

Sounds like sci-fi, but the first incarnation of these Autonomous Underwater Vessels (AUVs) has just been demonstrated at the ports of Lisbon and Piraeus. Lisbon’s first issue was closing the gap in the security on the waterfront.

Daniel Roythorne of BMT Group explained to MJ: “Landside security measures can be relatively simple to deploy, but the waterfront remains an easier target.” The potential threats from both organised crime and terrorism are many and varied, however, as Mr Roythorne explains: “While the risk is difficult to quantify, underwater attacks have been carried out in Sri Lanka with evidence that Al Qaeda has also considered using this tactic.”

These small, robust 1.8m torpedo-shaped AUVs connect with modems seated below the surface to link with the brains of the outfit onshore. Since the modems can be strung out on a chain across the port, handing over the data link from one to another, the AUVs can remain connected even when far from base, keeping up a harbour patrol day and night.

As the AUVs can be controlled in three dimensions, being able to rise or submerge with the help of vertically aligned thrusters, the units can thread through the water below the hulls of smaller craft, ideally at about 10m depth – bigger ships have AIS signals to allow them to be avoided - scanning the area with sonar and/or cameras. If it finds an anomaly it will quietly head toward it to investigate. Mr Roythorne explained the AUV heads in to scan over the object of interest four or five times, a process that at present takes 20 to 30 seconds “but this is a figure we can improve on”. Further, the battery system is quiet, so there may be little to give the AUVs presence away, a useful ‘stealth’ characteristic.

What has made all this possible are the giant strides in computing power and programming: the software can differentiate between a diver and a dolphin at a distance of up to 100m, partly through movement patterns and certain kinds of consistency in the signals.

Although the operatives on shore can direct the AUV for in-depth investigation it remains capable of autonomous work patterns: one very interesting development that is only a handful of years away is the ability to find a ‘plug’ on the seabed and head for it for an inductive recharge. For the moment, however, the robots are reliant on a change of batteries.

It’s not just security that can be answered by this kind of AUV, other ports are interested in continuous environmental monitoring and a previous project developed robotic fish that could sniff out pollution. Another element could be the checking of the integrity of submerged structures, saving the need to bring in experts unless something shows up that requires more in-depth analysis.

Further, as Mr Roythorne explained, some ports are plagued by shifting silt. “One port had a recent issue with a floating crane that kept grounding: it meant an expensive emergency dredge. If it had managed to be tipped off earlier as to what was happening below the surface the remedy wouldn’t have been so costly.”

Which brings us to money: happily it’s not as expensive as some might imagine. In fact, this element has been kept down to the bedrock and is the reason for not simply reinventing the high pressure oil and gas support ROVs: a single, basic AUV may come in at about EUR30,000 while a whole system, with modem transmitters, deployment and a couple of AUVs thrown in should only set a port back EUR100,000. In fact much has been omitted to give a fundamentally affordable system: “For example, an off-the-shelf mechanical sonar has been used as it costs a
fraction of a multibeam device," he explains. "We did a lot of research just to source a readily available unit, the one we've used was just one of two that came in at around EUR7,000." Even the signalling stations are based on established, off-the-shelf modem technology.

Likewise there has been a careful carving out of the propulsive power. Mr Roythorne points out the AUV is made of a robust and lightweight fibreglass (a useful safety feature if it does actually come into contact with some other craft) and so at present the units are fitted with relatively low-power thrusters. This means while the AUVs can deal with calmer waters, this incarnation might have a harder time fighting against strong tidal flows.

He explained it goes further than the budget, it is also about the overall power balance: “Yes, we can fit more powerful thrusters, but go too far and then the battery power becomes an issue. The fact is, it's always going to be a compromise between power, operational time and payload.”

Still, the AUVs have flexibility at heart, and from this foundation the AUVs could be tailored to fit a many kinds of operation: a port interested in very detailed mapping might want to raise this capability, or if it wants to inspect structures, it may consider a higher spec camera.

Underpinning this the software architecture has been kept as open and generic as possible to allow a change of sensors, cameras or other devices, so while not quite ‘plug and play’, the AUVs are fundamentally flexible enough to answer a number of needs – both present and future.

By Stevie Knight

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