Working Towards Autonomous Harbour Security

There is cross-fertilisation between equipment used for security in the domain below the water surface and hydrographic and oceanographic equipment and requirements. We are seeing increasingly more traditional military technologies being adapted for use in the homeland security market. This article shows this relation by the use of sonar technology for security systems and the development of unmanned surface vehicles able to carry a variety of equipment and thereby also suitable for hydrographic-related tasks.<P>

Any tool or service bought for security purposes is largely an insurance policy – in ordinary use it does not contribute to either profitability or operational effectiveness. In fact, the reverse is true: security measures are generally a drain on finances and manpower for any enterprise. Where such measures offer benefit are at times of extraordinary operation where a properly executed security response has the ability to prevent massive collateral or capital damages or p[rivacy breaches – the extent of which can dwarf the original capital outlay and operating cost of the systems deployed.
Given that the largest ongoing cost is generally supervising manpower, the ability of any harbour security measure to independently or autonomously detect, deter and defend against intruders will be key to the widespread success of such measures.
QinetiQ's Cerberus is a high-frequency wide-band active diver detection sonar that utilises their extensive pedigree in long-range mine hunting sonar (8 1). It offers a massive volume of cover from a single compact unit, achieving ranges of up to 2,400m in diameter.

Massive sonar operating potential does not, of course, in itself make a successful protection device. Wide-band's inherent advantage also delivers a large number of potential non-threat targets (clutter); in dealing with this initial problem, the first steps towards autonomy (or at least independent operation) are made. The computer is far more capable than a human operator at sifting through the few thousand potential targets presented with each ping, tracking them for a period to observe any motion and presenting detected tracks to an operator. Early in the Cerberus Development history, in certain circumstances, large numbers of real tracks but false threats (for example, fish, flow or tidal clutter) which if operational would have required a greater attendance. With growing filter sophistication and the merging of combined tracking/classification processes, the number of false threats is now hugely reduced – minimising the manpower requirement.

Only in relatively benign circumstances can operations be declared truly independent – i.e. calling an alarm only against real threats. For example, a flow filter will remove the effects of tidal clutter near the sonar, but filters may need to be reset when the clutter pattern changes. As operational experience continues to be amassed, increasingly more filter improvements will gradually reduce the operator manning time to a minimum – with of course the long-term aim of unmanned operation. Throughout this, it is important to remember that false alarms are not necessarily a bad thing: a total lack of false alarms generally means that system sensitivity has been mitigated to such an extent that a real threat could easily be missed; false alarms also remind the operator that the system is working – maintaining operator familiarity.

Once a target has been confirmed, the next step is to consider the response mechanism. Attitudes, laws and approaches to response vary hugely through the world – and can involve a range of techniques from acoustic deterrents, deployment of percussion charges through to grappling or direct subsurface combat. The type of response will also vary with threat level.

Acoustic response mechanisms are currently in their infancy but perhaps offer the greatest potential for effectiveness. Developments around the world in sophisticated human effects, portability and environmental responsibility will lead rapidly to operational capability.

Acoustic warning devices and acoustic response mechanisms importantly offer the ability for either a controlled or semi-autonomous response to be delivered – either as a warning or as an escalating defensive measure. Thus we can envisage the 'acoustic defender' acting as an invisible barrier to a harbour – a Cerberus system continuously monitoring the approaches, a loud hailer to warn a lost non-combatant, or more likely to offer a mechanism to distinguish between the innocent cetacean and the true threat as it zips off at thirty knots in response to the loud hailer. Finally, a more resolute response can be delivered by a mobile acoustic deterrent intended to raise a combatant from the depths.

With environmental concerns often paramount, collocating an acoustic deterrent with Cerberus is not necessarily the best choice. A better alternative is to consider a mobile, lower power, preferably unmanned deterrent that can be taken to the breach.
To this end, from their experiences with remote-control mine sweeping systems during the Gulf War, QinetiQ have developed Sentry. This personal watercraft-based Unmanned Surface Vehicle (USV) offers the potential for a second-stage decrease in supporting manning levels for any harbour defence system. A range of potential responses could be carried by such a system – for example, short-range acoustic deterrent (short-range systems will always be attractive in consideration of environmental interests) or percussion charges. The resolution of Cerberus as a fire control system and the ability for a warning to be issued well in advance of encounter allows precise

positioning of craft relative to threat for inspection, confirmation and prosecution.

The Sentry USV, however, has been developed as a platform available for multiple uses depending on payload options. This means that Sentry could also be deployed for hydrographic purposes offering the ability for hydrographic surveys in hostile waters.
Developments in subsurface harbour security are continually and rapidly decreasing the amount of human interaction required for day-to-day effective protection. Cerberus offers the first step in this, with minimal supervision requirements. Future integration of response mechanism chosen to suit the operating statutes of the owner with an autonomous or remote-control surface craft allows the complete operation to be performed largely free of human interaction ensuring that the through-life costs of deployed security measures are minimised and the manpower requirements are at a zero or very low differential from current security operations.

E-mail: chris.minto@6-echo.com