Teledyne Marine Belgian Navy trials recovering the Gavia AUV. *(Copyright Teledyne Marine)*

Taking The Man Out Of The Minefield

The year 2016 saw significant milestones achieved in the fielding of a system of robots for mine countermeasures (MCM), which is likely to see traditional minehunter vessels in future perform more of a stand-off role. The coming months promise even more developments in terms of collaboration between different unmanned systems, but full autonomy is still some years away.

By Anita Hawser

The "weapon that waits"—sea mines—are reminiscent of conflicts past. In World War II, the Germans reportedly laid more than 120,000 mines and 30,000 minesweeping obstructors in Northwestern Europe alone, which sunk hundreds of British warships. But sea mines have been used as recently as the 2011 Libyan conflict and the First Gulf War, which saw hundreds of mines laid in the waters off Kuwait and Iraq's Fao peninsula.

During minesweeping operations in the First Gulf War, the US cruiser *Princeton* and the helicopter carrier *Tripoli*, were damaged by mines believed to have been planted by Iraq. During the Iran-Iraq War in 1988, the vessel *USS Samuel B. Roberts* was almost sunk by a moored Soviet mine laid by the Iranian Navy in the Persian Gulf.

In the Libyan conflict, Gaddafi forces laid anti-ship mines off the port of Misrata to prevent humanitarian aid ships from reaching shore. Mines and underwater IEDs are cheap to acquire or build and can remain undetected for years. Today, most Navies use minehunting vessels carrying towed sonar arrays for detecting sea mines. Classification and disposal is carried out by remote-controlled or unmanned underwater Mine Disposal Systems such as the Royal Navy's SeaFox, for example. Clearance divers are also still used.

Traditional minehunter vessels are made from glass-reinforced plastic so they don't trigger sea mines that are activated by a ship's magnetic signature, but they are costly to acquire and maintain and slow moving. "Navies don't want to buy minehunting vessles any more," remarks Dominique Mallet, mine warfare business manager at French company, ECA Group, which manufactures a range of robotic mine countermeasures (MCM) solutions. "They [minehunters] are not designed to go far, whereas unmanned systems offer additional operational capabilities and can go far away for a long time."

A SYSTEM OF ROBOTS

Navies first dipped their toes in 'robotics' using remotely-operated vehicles to hunt for and dispose of sea mines. But various Navies are now looking to make the transition from traditional minehunter vessels to the next generation of MCM based on a system or robots or unmanned systems for detecting, identifying, classifying and neutralising mines.

The year 2016 saw a number of significant technological milestones in the area of unmanned MCM. In an indication perhaps of the maturity of the technology in this domain, French-based ECA Group delivered several fully robotised underwater mine countermeasure systems to navies. ECA says the mines can now be detected using high resolution sonar fitted to unmanned underwater vehicles (UUVs), minimising the need for the mother ship or minehunter vessels to enter the danger zone.

Once the sonar has detected potential mines, inspection robots are used to identify and confirm, via video images, that the object is indeed a mine. A remotely-operated disposal vehicle is used to destroy the mine. The robots can be launched either from a mother ship or remotely deployed from an autonomous surface vessel (ASV). Keeping the traditional vessel in a stand-off position relaxes the design constraints of the ship, says ECA, making the robotic platform less expensive than conventional minehunters, while offering a faster means of reaching the operation zone and more flexible mission configurations to perform other tasks such as maritime surveillance.

"The trend is to do offboard MCM," says Mallet of ECA Group, which has developed a family of unmanned vehicles for a wide range of MCM missions, including mine disposal in shallow waters using its Inspector MK2 ASV fitted with a front and rear sonar. Mallet says the ASV can have real-time data transfer to a ship 10 km to 12 km away so the ship can stay far away from danger. ECA's system of robots could also be used for civilian applications such as harbour security, dispensing with the need for a dedicated ship for mine detection.

NAVAL DEMONSTRATIONS

ECA demonstrated its technology for the Belgium Navy's Unmanned MCM Trials in the North Sea in mid-September. The trial evaluated the operation of unmanned MCM systems against legacy equipment currently used by the Belgian Navy. The Belgian Navy's legacy MCM system is comprised of six Flower-class Tripartite coastal minehunters with hull-mounted sonars and a remotely-operated vehicle (ROV) in the minefield.

For the trial in the North Sea, ECA fielded its autonomous underwater vessel (AUV), the A9-M, a 70 kg underwater vehicle with an endurance of 10 hours. The A9-M, which is already in use with the French Navy, can be deployed and operated from rigid hull inflatable boats by two operators or from coastal patrol vessels. For the Belgian demonstration, the A9-M was deployed from a RHIB, which was offloaded from a coastal patrol vessel. ECA Group says the A9-M dived for five hours, covering an area of a square kilometre, with 200% coverage of the surveyed area, enabling detection and classification of more than 100 potential Mine Like Objects on the seabed.

Further trials of unmanned MCM systems are planned by the Belgian Navy in spring 2017. The UK's Royal Navy is also trialling unmanned MCM systems. During Unmanned Warrior 2016, one of the largest demonstrations of unmanned maritime and air systems ever staged for the Royal Navy off the west coast of Scotland in October, minehunter ships tested robotic submersibles with advanced sonar for seeking out dummy mines.

An EOD mobile unit adjusts UUV bouyancy during Open Spirit in the Baltics *(US Navy photo by Mass Communication Specialist 2nd class Jared Walker)*

NATO CMRE's NRV Alliance vessel for underwater research *(Copyright, NATO CMRE)*

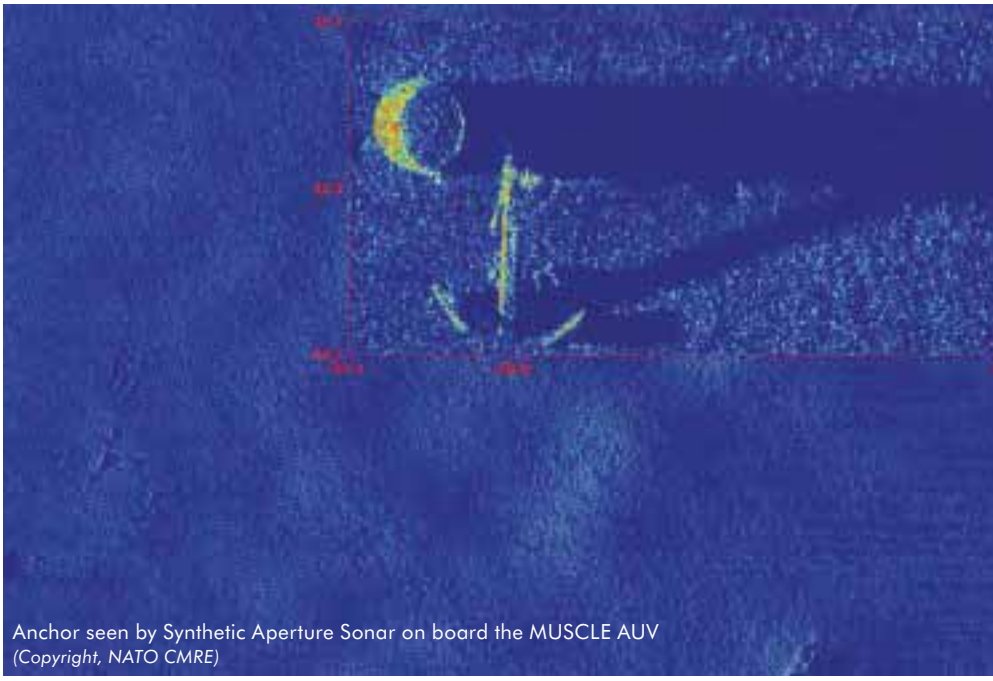
The minehunter ships were pitted against unmanned surface minesweepers, such as Atlas Elektronik's ARCIMIS unmanned surface vehicle. The ARCIMIS carried Northrop Grumman's AQS-24B Synthetic Aperture Sonar—used by the US Navy—through a simulated minefield. Unmanned Warrior also saw Saab's newly launched anti-IED (Improvised Explosive Device) underwater robot, SEA WASP (Waterborne Anti-IED Security Platform) operated as part of the Royal Navy´s Fleet Diving Squadron in search missions of harbours and to counter underwater IED and mine threats.

Under the Maritime Mine Counter Measures (MMCM) programme, which was instituted in 2010, the UK and France are collaborating on a jointly developed prototype autonomous system for detecting and neutralising sea mines and underwater explosive devices (see box). "A fully unmanned capability would provide benefits such as increased mission tempo, through higher coverage rates with reduced time on task, an ability to keep the man out of the danger zone and, through greater system autonomy, reduced manning," the France UK MMCM programme manager explains.

An unmanned technological solution would also offer a flexible incremental acquisition approach (enabling effective system enhancements and effective obsolescence management) and initial procurement. Through life costs are expected to be comparably more cost-effective than current MCM capability. "Of course the Navies want to maintain, in the future, current capabilities of maritime security and force projection and unmanned system capabilities would be better able to adapt to and defeat an evolving threat," says the MMCM programme manager.

Euronaval 2016 also saw Thales announce Pathmaster, an unmanned MCM system, which features Thales's latest generation, high-resolution synthetic aperture radar. Pathmaster can be operated from shore, a mine countermeasures vessel or any other naval platform and can be used for the detection, classification and location of mines. It can be tailored to the needs of individual navies, whether emerging naval powers or already well-established maritime forces.

André Buhart, senior sonar expert


Anchor seen by Synthetic Aperture Sonar on board the MUSCLE AUV *(Copyright, NATO CMRE)*