

The Robotic Boat

by *Keith Henderson*

Keith Henderson is Director, 5G International Inc and Editor of Jane's Marine Propulsion. He has authored a number of books on marine engines and writes regularly for the marine and trade press. In this article he describes the route to today's unmanned maritime vehicles and discusses the benefits of unmanned surface vehicles.

In times past, the only way to gather information about what was happening in or on the seas was to commission a vessel and crew to put to sea and carry out the task whatever that may be. Gradually, it became possible to do certain tasks without the direct participation of humans, starting with static devices and then moving on to unmanned underwater vehicles (UUVs) and remotely operated vehicles (ROVs) which have been in use now for many years.

In the unmanned world of the sea, what is relatively new is the Unmanned Surface Vessel (USV) although the first USV deployed by the United States Navy was the OWL, patented by R.J.Murphy in 1985. This was a jet-ski size of craft used for surveillance purposes. In the last decade interest has grown in USVs for tasks other than surveillance, for which they are most suitable.

In today's world, seagoing and coastal assets are becoming threatened by a number of dangers due to their vulnerability. The ever-present danger of piracy and its threat to human life as well as the cost of commercial damage is on the increase. The potentially more dangerous threat is the seaborne terrorist – a handful of people with explosives and handguns can wreak military, economic and ecological havoc to the open society in which most of the world lives.

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The total length of the world's coastlines is about 504,000km, enough to circle the Equator 12 times. But the majority of seaports, harbours and coastal regions of the planet lie unprotected from virtually every threat from small-craft attack, bio terrorism, infrastructure contamination, sea-container ordnance smuggling, marine mines, etc.

More than half the world's population lives within 100km of the coast. This is more than 3.1 billion people. Rapid urbanisation will lead to more coastal mega cities containing 10 million or more people. Even now, 13 out of 15 of the world's largest cities are located on or near the coast. Growing population in coastal areas leads to more marine pollution and disruption of coastal habitats. Some 6.5M tons of litter finds its way into the sea each year. Invasive species, and biological and chemical threats are providing bigger, more inviting targets.

Ensuring Coastal Integrity

The vast portions of international coastlines, harbours and waterways are unprotected from the new threats focused on creating disruption and chaos by targeting either the host country directly or vessels visiting that country's ports. These features are highly subject to compromise by coastal mines and intrusion by small, fast-moving attack vessels. These attack vessels are designed to disrupt ports and international shipping lanes, inhibiting the movement of oil and other goods/commodities. The perception of being able to securely move goods and trade by sea would be severely damaged. Many regions of the world have not faced a viable threat by sea for half a century. The lack of a need for self-protection in this specific regard has resulted in a regional infrastructure which is unprepared.

In addition, there is lost revenue associated with commercial smuggling, illegal immigration and illegal drug trafficking. A secure coastal and port environment must be maintained to ensure that international vessels continue to call at all regional ports and that sea trade is not interrupted.



5G International Inc's seven-metre Interceptor USV during testing in Florida [5G International Inc]

Military Trends

Looking to military trends we see more and more use of unmanned systems in each subsequent conflict because of their ability to provide an effective cost-saving and life-saving solution to many situations. Given that many nations have enemies with millions or billions of dollars at their disposal, we must prepare to provide security to assure our way of life. Through the manufacturing and ongoing development of small robotics customised for each category of deployment, we can avoid placing humans in harm's way.

A USV is basically a boat with sensors and may be armed. Being unmanned it is unaffected by bad weather, assuming a seaworthy hull; it can loiter indefinitely, assuming a sufficient energy supply; and with satellite communications it can be controlled and report from anywhere to anywhere. In standby mode the communications suite and positioning thrusters can be powered by solar cells and/or wind generators. If required, the USV can 'sink' to the waterline and become virtually invisible to the eye and radar. When required it will rise up with main engines started ready to make an intercept or give chase.

A robot to collect data can be used for the following: surveillance [radar, sonar, video] and on-site automated

analysis [chemical, biological and radiological], vessel tracking and signature recognition, chemical (ion-specific electrodes, spectroscopic), optical (blob analysis), and audio/sonar specific signatures. Small sensors and detection systems for vessels and land-based computers are cost-effective and available. These systems have been built, tested and operated. They are available now.

Financial Benefits of USVs

The financial benefits are also in its favour. The build-cost of a USV compared to a patrol boat is clearly much less, and one operator can supervise up to four USVs at one time with electronic assistance (e.g. in swarm or semi-autonomous mode). Depending on the operation (e.g. in action), up to two operators per USV would be advisable. These extra personnel can be 'on call' doing other jobs and only used as required. This option is not available for a ship at sea where all crew members must be onboard. During normal patrol duties one operator for four USVs would be enough. In comparison, one patrol boat will have upwards of five crew, with four crews to give a 24/7 capability: the cost saving is obvious.

A USV can be armoured and armed, and being unmanned has additional operational advantages such as no-fear, and in the end is expendable: there is no crew to be taken



Two technicians testing the Littoral Combat Ship Anti-Submarine Warfare (LCS ASW) Mission Package, developed by the Naval Undersea Warfare Center Division, Newport [US Navy]

hostage. It can close in to a ship on fire or a chemical spill without endangering human life. Asymmetric warfare is with us, as the world saw with USS *Cole* where a 7m rigid-hulled inflatable boat (RIB) costing a few thousand dollars disabled a destroyer, doing \$250M damage.

Sensor suites for mine-hunting are also ideally suited to USVs as sweeps can be made with repetitive monotony and accuracy as good as, if not better than, with manned craft. Bottom imaging and sub-bottom imaging can be carried out automatically in fully autonomous mode and again without endangering human life. For search and rescue purposes a USV could be air-dropped and its IR sensors used to find people in the water and deploy life rafts. The possibilities are many, restricted only by imagination and inertia!

We see the first USV applications being military, primarily for MCM roles and gradually patrol boat type of applications for sentry and intercept duties. Several companies are marketing remote-controlled, gyro-stabilised machine guns that can be mounted on a USV. When equipped with a Hellfire or Javelin missile, it could attack other surface vessels or conduct precision strikes ashore.

Layered Defence

We have recently seen USVs being integrated as an essential part of layered coastal defence systems such as the HALO System+. The USV is used to interrogate approaching vessels at a sufficient distance to leave time for an appropriate reception to be activated should the target vessel be hostile.

The US Navy is currently testing a USV created by the Naval Undersea Warfare Center in Newport, Rhode Island for the LCS programme and will make future unmanned mission packages for a number of applications.

The Israelis have a number of USV models. One of the better known models is Rafael, which has developed the Protector



The Raphael Protector USV is equipped with a Typhoon mini-gun and Toplite Electro Optical system [BAE Systems]

USV in conjunction with BAE Systems and Lockheed Martin and has already assisted security operations in the Mediterranean and the Persian Gulf. It is equipped with a Typhoon gun which can be coupled to a Toplite electro-optical system or used independently. The vessel has been designed to operate either on its own, or as a security asset for a larger vessel to enhance force protection.

5G International Inc, Florida produces a 7m and an 11m USV, but is not just eyeing military contracts: "We are very interested in the commercial and semi-governmental market", says 5G International's CEO Robert J. Murphy. "We're interested in the commercial and patrol boat market as well as scientific exploration and other specialist unmanned vessels."

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Handling System

One of the principal difficulties/objections to USV deployment at sea has been the physical problem of launching and recovering them, especially dangerous when the mother ship is under way with a sea running. 5G International has solved this problem and added a refuelling capability with their patented Marine Handling System that is currently under development.

Why have USVs not been embraced more widely by the world's navies, given their obvious potential to perform dangerous and dull missions? One problem is space. Warship real-estate is expensive. USVs, their control systems and maintenance areas have to compete for space with other essential ship and marine warfare systems. For USVs to become even more attractive, their manpower and equipment demands need to remain as small as possible.

While USV development may not have garnered the column inches that UAV innovation has, it is clear that developments in this exciting branch of the unmanned vehicles community offers similar benefits and possibilities to perform the dull, dirty and dangerous missions routinely performed by pilotless aircraft. ■