Boats without Sailors

The maritime environment is well known for its inherent dangers, quite apart from those always present in naval operations. Small wonder, then, that "those in peril on the sea" are right out there in the use and development of unmanned vehicles to help accomplish the mission. And just as any Navy has ships, submarines and aircraft (well, aircraft in close support anyway…), so too there are UVS that float, sink and fly.

After successful testing in 1986, a Pioneer unmanned system was deployed on USS Iowa.

PHOTO: PIONEER UAV INC

As might be expected, the US Navy has been somewhat of a 'pioneer' in this business, at least on our side of the Atlantic. Indeed, according to the Pioneer UAV Inc., in the 1980s United States military operations in Grenada, Lebanon and Libya identified a need for an on-call, inexpensive, unmanned, over-the-horizon targeting, reconnaissance, and battle-damage-assessment (BDA) capability for local commanders. As a result, in July 1985, the US Secretary of the Navy directed the expeditious acquisition of unmanned aerial vehicle systems for fleet operations using non-developmental technology.

A competitive fly-off was conducted and two Pioneer unmanned aerial vehicle systems were procured in December 1985 for an accelerated testing program to be conducted during 1986. The initial Pioneer system delivery was made in July 1986 and subsequently deployed on-board the battleship USS *Iowa* in December 1986. During 1987, three additional systems were delivered to the USMC where they were operationally deployed onboard LHA-Class naval vessels as well as with several land-based units. Pioneer UAV Inc states that the Pioneer system became a genuine joint service program in 1990 when the US Army fielded their Pioneer system. Is the Navy always ahead of everyone?!

In addition to using the Pioneer system successfully in the Gulf War and operations in the Balkans, the USN has used UVS extensively in mine clearance, describing underwater UVS as the main workhorses of the mine clearing effort in Operation Iraqi Freedom.

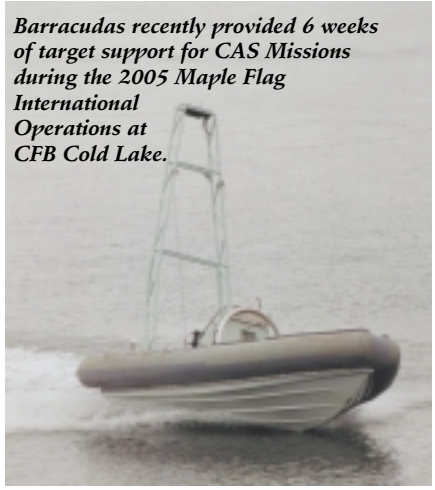
And, in late 2003, the US Navy News heralded the deployment on USS *Gettysburg* (CG 64), of the 'Spartan Scout' as a 'harbinger of transformation'. The Spartan is a modular, reconfigurable, multi-mission, high-speed, semi-autonomous unmanned surface vehicle (USV) capable of carrying payloads of 3,000 and 5,000 pounds for seven-and-11-meter craft, respectively. Integrated as an expeditionary sensor and weapons system designed to be a primary "force-leveller" against asymmetric threats, it enables a battle force commander to match inexpensive threats with an appropriate response.

Canada Keeps Pace

The Canadian Navy is also investigating uninhabited vehicles. Working in very close cooperation with Defence R&D Canada, work has been going on since the 1950s in such areas as tethered systems, various remotely controlled devices and of course, the notable experiments conducted under the aegis of the Canadian Forces Experimentation Centre (CFEC).

The Pacific Littoral ISR Experiment (PLIX), conducted in summer 2003 has been extensively described elsewhere. In addition to the surveillance of shipping conducted using the Israeli Aviation Industry 'Eagle', the Navy experimented with an unmanned surface vehicle, designated "Barracuda." This vehicle owes its origins to the Canadian Patrol Frigate project, with a call to Schreiner Target Systems for drones for surface gunnery. As with the USN Spartan system, the additional capabilities inherent in the system quickly became obvious. While the payload selected for the experiment conducted off the West Coast was a twelve-inch EO/IR gyro-stabilized rotatable camera provided by L3/WESCAM, the experiment clearly demonstrated the raw potential of the USV concept.

The PLIX was followed closely by the A(tlantic)LIX. The second ALIX scenario (peace-support) called for a maritime surveillance and targeting mission in the Gulf of St. Lawrence, in which the General Atomics' ALTAIR UAV transmitted beyond-line-of-sight data and imagery via the Ottawa Remote Operating Centre across the integrated ISR architecture to a Joint Force Commander at MARLANT HQ. It also provided this data and imagery directly to the Canadian warship HMCS *Athabascan,* which was participating in the operation. It also flew over the Gagetown training area in New Brunswick (coinciding with ARCON 2004, the annual concentration exercise for Army Reserve units in Land Forces Atlantic Area), providing reconnaissance and targeting information to the local ground force commander.



Barracudas recently provided 6 weeks of target support for CAS Missions during the 2005 Maple Flag International Operations at CFB Cold Lake.

PHOTO: MEGGITT DEFENCE SYSTEMS CANADA

Over Gagetown, the ALTAIR operated at the same time as another joint forces asset, a Silver Fox Mini UAV. In the future, in a marine environment, such local area surveillance could be used in scoping out potentially hazardous situations such as a vessel targeted for boarding or a nearby littoral environment which might be the destination for a landing party or a target intending to close with the ship itself.

In addition to the experiments, our Navy has some recent operational use of UVS. The most notable example, as reported at UVS Canada Symposium last Fall, was during the Swissair recovery operations where a variety of tethered remote vehicles were used to survey the crash site to guide manned diving operations. During this operation, the Deep Access Remote Television (DART) vehicle was deployed in rough weather in a successful attempt to map out a safe manned debris recovery operation – a classic unmanned vehicle employment case study. Subsequently, the large Deep Seabed Intervention System (DSIS) was deployed, first in HMCS *Glace Bay* for three weeks and then in CFAV Endeavour for four months. This heavy weight vehicle recovered a significant amount of material, in conditions in which divers could not operate.

The Bottom Object Investigation Vehicle (BOIV) unmanned vehicle, operated from a Kingston-Class MCDV was also used to investigate a small plane crash site off Orcas Island last year as well – a case in which the employment of an unmanned system can be used to greatly expand the inherent capability of a manned platform. The BOIV, as well as the DART and DSIS mentioned above, were all built by International Submarine Engineering (ISE) Ltd., another Canadian company pioneering remotely operated vehicles.

Naval experts are quick to point out, however, that a UVS is just another sensor to feed into the maritime information environment in support of Navy command & control. They note that there is already a lot of data out there; making sense of the data to achieve full situational awareness appropriate to the security environment and task at hand is the core of the problem.

Our Navy is busy upgrading the Marine Security Operations Centres or MSOCs: to make sense of the information which we are getting and which will be provided not only by future sensor systems but also, and probably more importantly, through increased cooperation with other government departments and allies. The two existing Maritime ISR centres (TRINITY on the East Coast and ATHENA in the West) will be used as the foundation for the Marine Security Operations Centre concept. Naval officials explain that once operational (before the end of the decade) these Centres will be the focal points for the collection, management, analysis, fusion and exchange of ISR information in support on domestic marine security.

The Navy is also exploiting the technology inherent in High Frequency Surface Wave Radar (HFSWR), which has over the horizon capability to detect ships and aircraft. Two development sites will be operational by July, with another five in the books for development. These will go along way to address some of the gaps in providing maritime coverage in the regions deemed most important to Canada's maritime security.

The Navy also admits that one of the biggest problems is in associating the information received from multiple sources with a specific target. The Multi-Sensor Integration within a Common Operating Environment Technology Demonstration Project is a first step to developing an automated data fusion capability for maritime surveillance. Using an advanced model of the US Common Operating Environment computer architecture, it is incorporating new fuzzy logic engines developed at DRDC(Ottawa) to demonstrate automatic fusion from dissimilar surveillance sources (including HFSWR) and will be demonstrating the capability to the operational community over the next 4 years.

What Next?

The Navy is throwing itself into trials with the 'Silver Fox' with great gusto, looking at the specific issues of integrating unmanned vehicles, ships and surveillance architectures. In addition to the local surveillance work already 'experimented', the kinds of things being looked at include smaller payloads for Electronic Support Measure (ESM) use, communications relay, targeting and battle damage assessment, remote sensing of toxic or radiological hazards or, given the relatively stealthy nature of these small quiet vehicles, covert tracking of targets in constabulary work at sea.

Described as probably one of the biggest practical challenges to be addressed, there's the problem of the safe launch and recovery of UVS from a ship.

Looking about to see how others are working on this conundrum, it's worth looking at our cousins to the South again. From exploring the omniscient 'WWW', one learns that the stalwart Pioneer system uses shipboard-net or land-based runway-arrestment recovery systems.

According to the Boeing Aircraft web site, US ScanEagle is launched autonomously via a pneumatic wedge catapult launcher and flies pre-programmed or operator-initiated missions guided by Global Positioning System and its onboard flight-control system. It is retrieved using a "Skyhook" system in which the UAV catches a rope hanging from a 50-foot high pole. This patented system allows ScanEagle to be runway independent and operate from forward fields, mobile vehicles or small ships.

Lest anyone is really worried that things are getting out of hand, consider this: for the past couple of years, the Massa Products Corporation of Hingham, Massachusetts has been working on the development of an underwater robot to find mines in the shallow water in-shore areas of harbours and coastlines… Dubbed "Robo-Lobster" by the *Wall Street Journal* and its Congressional supporters, the robot moves in the fashion of a real lobster. Several prototype robots have been built resembling the American lobster, with eight legs, claws and antennae on the front of the vehicle. So even if we have ships without sailors, we can look forward to a Navy that still values lobsters, and that has to be a good thing.

See the story at: http://www.massa.com/underwater_whatsnew.htm

The Navy is also following Advanced Ceramics Research potential development of a net landing system for the Silver Fox.

And as if a more obvious approach had been overlooked, consider the mini-helicopter type solution being offered with the USN and Marine Corps vertical, tactical UAV, dubbed the 'FireScout'. If you must land on a ship, why not do it like a helicopter, including some 'beartrap' variant? One wonders if anyone has asked Bombardier to revive the "Peanut"?

The Navy is also pursuing the further applications suggested in the Barracuda surface vehicle experiments. Potential applications particular to littoral ISR missions potentially include ESM triangulation, ASMD/jamming/deception, and MIO support.

The potential for vehicles like this for a wide range of missions is of interest to a large number of navies both small and large and Canadian industry's lead in some of the technologies involved is said to be gaining international recognition.

DRDC is not out of ideas yet either. In the realm of submerged systems the development activities range from the Theseus project (which was used successfully to lay 175 km of cable under ice and return to the entrance hole for extraction in an experimental programme of under ice monitoring and data collection in the 1990's), to the much smaller Slocum Glider. Deriving its forward motion from the hydrodynamic control surfaces that force it forward in commanded paths as the vehicle alternately rises and falls in response to water ballast pumping, this vehicle, developed by Webb Research in the US, has an endurance measured in weeks and months and a range of over 1000 km, albeit at slow speeds. DRDC is using this vehicle to examine its potential for a range of missions and to explore concepts for its command and control over global distances. Developed originally for oceanographic work, its other potential uses could be surveillance, interrogation of remote sensors or communications tasks.

The Navy also notes that closer to operational implementation is a Canadian innovation in the exploitation of a remote mine hunting system employing a semi-submersible vehicle towing a mine hunting payload. This is a necessary capability if the Kingston-Class Minor Coastal Defence Vessel is to have the ability to safely search for modern bottom laid influence mines.

Commercial work in Canada is also well advanced. A fine example is that of Shark Marine Technologies Inc., of St Catharines Ontario, a manufacturer and supplier of Remotely Operated Vehicles, camera systems, oceanographic equipment and related services. With products with evocative names such as the 'Stealth, and the 'Seawolf", the company notes that they currently work on such defence-related tasks as swimmer and diver detection, hull inspection and early warning detection systems

The potential for exploiting good ideas in this area remains enormous. Naval officials note that we are working with our allies through NATO and especially with the US. Examples cited include:

- the Navy (in cooperation with the Air Force) has seconded an officer from the Helicopter Operational Test & Evaluation Force office in the US Coast Guard Deepwater Program UAV office;
- the Navy is also participating in NATO PG/35 on Maritime Tactical UAVs, They also work similar Air and Army groups in joint sessions to share information and address interoperability and airspace management issues; and,

- the CF has a Master Data Exchange Agreement with USN for the exchange of UAV technical information.

So it doesn't really sound like 'boats without sailors' after all!

It is evident that our Navy has been keenly exploring the best possible uses for robotic vehicles in the maritime setting, exploiting ongoing joint experiments and leaning heavily on the traditionally valuable support of the Canadian defence science community. In the meantime, every opportunity to use existing UVS is pursued. We are being well-served. FL

MGen (ret) John Leech, former GM of AFCEA Canada, is FrontLine's Defence Information Technology Editor.

The USN Master Plans for UVS are readily available on the US Navy website at: http://www.navy.mil/.

The author gratefully acknowledges the generous assistance and advice received in the preparation of this article from DND's Maritime Research Coordination Cell.