Uninhabited Vehicle Systems for the Army

The Vanguard™ Mk II EOD Robot flexes its talents. (PHOTO: ALLEN VANGUARD COMPANY)

The military uses, and indeed success, of unmanned (uninhabited!) vehicles have increased dramatically in the last few years with the airborne version of these robots, the UAV, seeing more and more action in roles characterized as dull, dangerous or dirty. Looking for an environment that fits the latter description, can one imagine a worse place than the land battlefield? It's no wonder, then, that we are seeing more and more initiatives to capitalize on the virtues of UVS in the land battle. Some enthusiasts cry: "The future is unmanned!"

The US Forces are obviously the leader in this area, with a depth of resources beyond most others. What are they looking at? A scan around in cyberspace reveals that the research and development people are working on various configurations of an Armed Robotic Vehicle (ARV) that could work in assault or reconnaissance roles, a Small Unmanned Ground Vehicle (SUGV) designed to creep about in caves and sewers, and even a MULE (Multi-Functional Utility/Logistics vehicle) whose name heralds instant relief for the grunt who must carry or drive loads of stuff in terrible places.

CANADA OUT FRONT

Since the Canadian Forces are certainly short of people, it's only logical that we have been exploring these ideas too. In common with our neighbours to the south, for years we have been exploiting remotely controlled robotic vehicles in such roles as mine detection and bomb disposal, clear examples of jobs where humans can be safeguarded. Indeed, we have a couple of the world-leading product lines in this business, with devices such as the FORESIGHT multi-sensor integrated landmine detection system and the Vanguard EOD (Explosive Ordnance Disposal) robot.

A team, led by General Dynamics Canada, put FORESIGHT together to satisfy the Improved Landmine Detection System program. According to the prime contractor, FORESIGHT is designed around a Scorpion remote detection vehicle that has the ability to pass over pressure-activated mines and mark them for disposal. The system uses multiple sensors and fuses the results to optimize the detection while minimizing the rate of false alarms. The Scorpion can be escorted by a lead protection vehicle to prepare the route and safeguard the detection components, both vehicles are remote-controlled from a Command Vehicle operation at a safe distance. Whew!

The Vanguard Mk 1 EOD robot was voted as the best performing and most applicable EOD robotics system by Battelle, a major U.S. corporation that conducted an independent, high-level performance evaluation of competing systems for the Technical Support Working Group (TSWG) of the U.S. National Institute of Justice. This robot was developed by Allen-Vanguard out of Ottawa; according to the company, it was engineered to satisfy a growing demand for a high-quality, lightweight, easily portable EOD robot with cross-functional capability to respond to bomb threats, HAZMAT operations, and tactical and surveillance situations. Bomb squad teams throughout North America, Europe and Asia are currently using it. The Mk2 includes quantum improvements and was probably the version featured in the popular TV program "CSI New York" to pluck fingerprints from a particularly sensitive environment. The company is proud to note that Allen-Vanguard products have been chosen by the Canadian Forces for their newly configured Combat Engineers Clearance Suite (CECS).

UP, UP AND AWAY

Moving up in altitude, the UAVs are very much part of the picture too. Many readers will be familiar with the term ISTAR (Intelligence, Surveillance, Target Acquisition and Reconnaissance.) An omnibus project of this name calls for

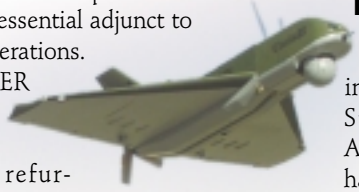
The FORESIGHT land mine detection systems prowls the prairie in its testing phase. (PHOTO: GD CANADA)

The Silver Fox mini UAV in a previous incarnation with the US Navy.
(PHOTO: ADVANCED CERAMICS RESEARCH)

(among other things) a family of UAVs to satisfy the need to look over the hill, and over the next hill(s) in front of an army formation. For a few years now, the Army, in conjunction with the Defence R&D Canada and the CF Experimentation Centre, has been participating in a series of UAV experiments to fulfill the beyond-line-of sight capability demanded by ISTAR.

The experiments to date have proven their worth, so much so that the CF employed one of the candidate systems (the General Atomics-ASI I-Gnat) in the security operation surrounding the G8 Summit in Kananaskis in June 2002.

Moreover, as Canada became involved in the NATO ISAF in Kabul, an urgent operational requirement for a tactical UAV was raised. In an expedited project, the CF purchased, trained and deployed the SPERWER system from an Oerlikon Contraves-SAGEM partnership in a very few months. Some media coverage focussed on the fact that several of these UAVs were damaged in use, but reports indicate that the system had the desired impact: timely information was provided to commanders on the ground which not only saved lives, but also stood as useful evidence in negotiations with local authorities. It also seems to have convinced a lot of sceptics that such a UAV is an essential adjunct to successful operations.



The SPERWER is now back in Canada for system refurbishment by the contractor, and 'Canadianizing' the support infrastructure before it can be fully exploited. (Even equipment needs an 'operational pause'!) One of the surprise bonuses of this intensive process has been that the Army gained a pile of information about how to use such systems and how best to exploit the information provided, arguably saving time and money that would have been spent on further stages of iterative experiments. There's nothing like the real thing to demonstrate Canadian ingenuity and resourcefulness. Indeed, it now appears that Canada is the second largest user of the SPERWER system in terms of hours flown (just behind the Netherlands), so we have been able to contribute to our Allies' experience in this regard.

The Army also has a 'time-share' in a mini UAV, the Advance Ceramics Research "Silver Fox". Purchased from THALES Systems Canada as part of a collaborative, CF -wide experimentation that will permit Canada's navy, air force and army, as well as Defence Research and Development Canada (DRDC), to enhance their understanding about the potential use of mini UAVs in the modern battlespace. The Army took delivery in Gagetown, where it was used in conjunction with the Atlantic ISR Experiment (ALIX) last summer. This has permitted further concept development work, as well as feeding into the other ISTAR projects on sensor fusion and overall integration with HQ staffs. The proper exploitation of a UAV obviously must take into account the technical and procedural implications of how the 'business' of a HQ works, as well as the infrastructure to support it and such mundane questions as who is responsible for its care and feeding (an Artillery Surveillance and Target Acquisition Battery is one of the current options.)

There is, of course, much more coming down the line, and not all in the air.

LOOK TO THE WEST

Any exploration of Army UVS inevitably leads one to Defence R&D - Suffield, in Alberta, where an Autonomous Intelligent Systems section has been formed to follow up on inspirational thoughts coming down from the Strategic Direction authorities in NDHQ. Indeed, Suffield has been the source or the godparent of UVS for some time. In the 1980's, for example, their ground mobility gurus produced a couple of remotely controlled robotic targets (the 'Badger' that moves on land and the Barracuda' that moves on the sea), which are still in use. The first minefield work there was a relatively simple, robotically towed electromagnetic detector being rushed into service for Somalia. From this effort grew the multi-sensor integrated system now known as FORESIGHT, described earlier.

Recent work has also borne fruit. What has been described as a serendipitous linking of the ground mobility and the nuclear, biological and chemical scientists resulted in the question: why not install a biological agent detector on board one of these wandering teleoperated vehicles and see if it would be possible to accomplish detection on the move? Show the results to the right staff, and all the support needed for a significant 'D' (for Development) project is quickly in place. A scant 18 months later, and the newly formed CF Joint NBC Company in Trenton is receiving a significant new capability called the MultiAgent Tactical Sentry (MATS). With the appropriate sensors mounted on board a modified Kawasaki Mule, an operator seated in a separate control vehicle is in charge. The detector vehicle can be steered around the terrain, the operator following on a video display, and getting dynamic indications on a moving map display. Not only that, but after the unmanned vehicle has been 'driven' around the area to be monitored (an airfield, for example) it can be told to memorize the route and repeat it as desired! This will give the CF what is described as an unparalleled capability. As this system is transferred to industrial production, one can only imagine that there will be international interest in this big step forward from the static, dangerous NBC detection techniques used to date.

BACK TO THE FUTURE

At Suffield there is also solid 'R' (for Research) going on in the area known as autonomous intelligent systems. The ground mobility crowd has morphed into the new section aimed at solving the problems of unmanned vehicle mobility, vehicle intelligence and multi-vehicle coordination. The focus, for a number of reasons, is on the urban or 'complex' warfighting environment as opposed to the open engagement work largely being championed in the US.

As an aside, the ongoing DARPA Challenge is evidence of the extreme difficulties of this kind of task. Enticed by the prospect of a $1 million prize, the cream of US academia and industry produced

about 20 teams that set out to construct vehicles that could autonomously travel a 142-mile course within a time limit. Eight of the 15 teams made it past the starting gate; only three made it over six miles… and none made it beyond 7.4 miles… a grand challenge indeed!

The clever folks at Suffield have begun work in the slower moving, but more complex urban environment, and to capitalize on the idea of many smaller robots working together. Imagine, for example, a foot soldier undertaking a building-clearing operation. Imagine the help this soldier could get from a swarm of robots – capable of sensing, reporting or even killing – a swarm entering from the basement, or the roof, or through holes in the walls at the same time! Any advantage an entrenched adversary may have had has suddenly evaporated (one is reminded of the creepy little spiders in the Tom Cruise film, *Minority Report*). It is also of note that this kind of capability could also be applicable to caves or other complex environments, where the restrictions on size, speed, and communications are quite different from the open battlefield. Mind you, this isn't going to happen as fast as MATS. The challenges of vehicle intelligence, on the level of the smarts of the vehicle itself, and its ability to operate autonomously, are so large, that experts agree that we will likely see a cyclical movement from the teleoperated robot (man in the loop) towards the level of independance that some describe as the "man **on** the loop."

FORWARD THINKING

Spend an hour with the forward thinkers in the CF Advanced Concept Development Team, and you begin to understand whence the impetus for some of these good ideas is coming. Tasked to look 20-30 years into the future, the concept of 'swarming' jumps out as worth pursuing. The Team has decided to look beyond manned systems to what is being called ACAR (Adaptive, Collaborative, Autonomous Robots). Here, the swarming is simply described as a control paradigm for groups of robots. Note also the order of the adjectives in ACAR: a logical progression from where we are today, to an era when we can really count on these machines to help us out, to help keep our soldiers out of harm's way.

(PHOTO: DEFENCE R&D SUFFIELD)

MATS Unmanned Ground Vehicle & LSVW Command Post with data link mast deployed.

To be sure, there are a lot of unknowns and at least as many significant challenges: there are the 'soft' issues of legality, morality and ethics (do we really want machines to kill people for us, or is that really a huge leap beyond some of today's programmable weapons?); will computing power really start to reach human brain capabilities as quickly as some believe? How do we get a handle on one of the most difficult aspects of this area of endeavour: trust? How and when will we be able to trust the robots to do their thing? Isaac Assimov, where are you when we need you?? There is a big, Congress-mandated push in the US to move forward here. Do we need a similar high level of visibility and support in Canada?

Wherever it goes, it is of note that the Army is spending considerable research resources on this, and that Suffield is developing the reputation as a world-class participant in this unfolding saga.

PROMISING PROGRESS

This quick review of the uses of UVS by the Army in Canada reveals a number of consistent themes and accelerating progress.

First, the Army is solidly convinced that robots can help accomplish many jobs while minimizing casualties to soldiers; indeed, our historical employment of such machines in the mine/bomb detecting and disposal roles has kept us in the forefront of global developments in this area.

Second, the experience gained in real employment in operations, which sometimes appears expensive, can often save time and money in the long run, and certainly allows a leap forward in 'lessons learned'.

Third, to fully exploit these devices, a spectrum of capabilities is needed, hence the ongoing procurement of 'mini' and 'micro' UAVs, different sizes of EOD robots, and the niche research in the area of autonomous intelligent systems.

Finally, and emphasized as overriding in every scenario examined, a comprehensive information environment surrounding UVS is absolutely essential. All these devices have more or less complex sensors on board, but without the ability to tell anyone, they remain at the novel experiment level. The primary interest is in the sensor, and getting the information to decision makers at the right level while minimizing the danger to our own troops. That is, until we can fully realize the adaptive, autonomous, collaborative and trusted capabilities…

Even with ACAR, one will still need to keep track of the beasts!

Moving ahead into the future, there is no doubt that UVS will continue to play a growing role in land force operations. Our Army is basing this evolution on solid experience, a clear understanding of the desired results and the implications. They are superbly supported by Canadian resourcefulness and ingenuity in strategic direction, research and development, and ultimately, Canadian industry. The overall picture is a model of what can be accomplished by clever folks who share the vision of accomplishing dull, dirty, dangerous tasks in a way that keeps our soldiers as safe as possible.

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