ROBOTICS AND THE CHEMICAL CORPS

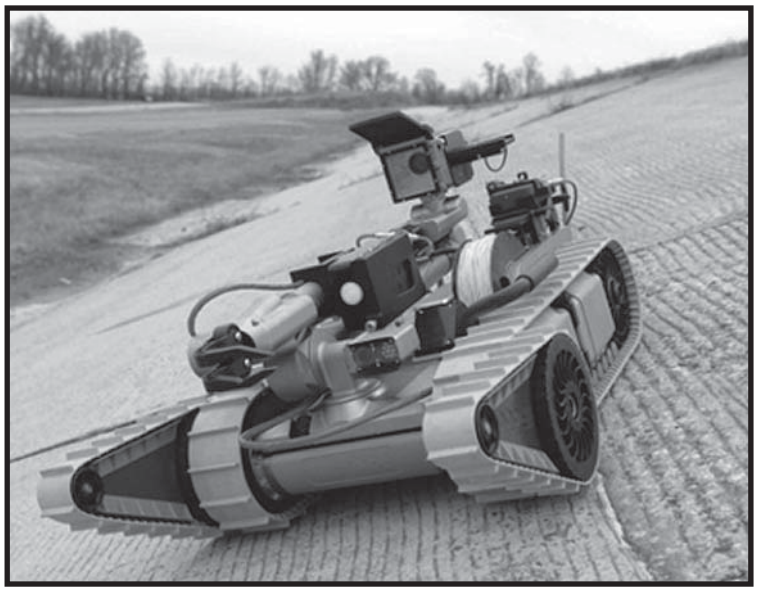
By Mr. Alvie Scott and Mr. John Moore

The *Buck Rogers in the 25th Century* television show and the *Star Wars* movies represent the best of 1970s science fiction entertainment. But now, using technology reminiscent of the fictional *Star Wars* characters R2-D2 and C-3PO, the Chemical Corps is approaching the ability to employ unmanned ground vehicles (UGVs) and unmanned air systems (UASs) containing integrated chemical, biological, radiological, and nuclear (CBRN) sensors in support of sophisticated and complex missions. And this is not simply for entertainment; the purpose is to limit the exposure of personnel to hazardous substances.

Many of the tasks that are regularly performed by CBRN reconnaissance and survey team members in potentially contaminated areas can be executed by unmanned systems in lieu of humans, thereby improving force protection. Unmanned systems allow an operator to remotely control the vehicle to facilitate initial-entry tasks and other phases of site assessment missions.

Robotics provide users with improved hazard standoff, increased mission speed, and enhanced availability and reliability. A few select units have been using CBRN sensor-equipped UGVs, and they have reported the successful accomplishment of their missions with these systems. Small UASs are primarily used for tactical missions involving intelligence, reconnaissance, and surveillance and homeland defense incident awareness assessment. UASs supply intelligence, reconnaissance, and surveillance; incident awareness assessment; and CBRN sensor information to the operator and the commander or staff. The operator evaluates the data and serves as a link in the overall architecture.

Numerous efforts to develop ground and air robotic platforms and sensors are continuing within the Department of Defense. The staffs of the Maneuver Support Center of Excellence, the Chemical Corps, and the Joint Program Executive Office–Chemical Biological Defense continue to experiment with CBRN robotics, but there are many technological issues that must be overcome to provide reliable, affordable systems that will support the tasks executed by Soldiers in the field. The Chemical Corps is particularly interested in the concept of a common-control device designed to support ground and air platforms. The immediate goal of the U.S. Army Chemical, Biological, Radiological, and Nuclear School (USACBRNS) is to, whenever applicable, capitalize on the efforts and achievements of those involved in operations in Iraq and Afghanistan. The USACBRNS and Maneuver Support Center of Excellence



The PacBot® UGV

Soldiers retrieve data from the UGV.

plan to consolidate the lessons learned from these initiatives and develop requirements for various programs of record.

CBRN Soldiers provide subject matter expertise to non-CBRN Soldiers and units. Combat units are the most likely targets of CBRN attacks and are the first to find themselves in harm's way. Consequently, robotic systems designed to provide Soldiers with initial remote or standoff detection and identification capabilities using a simple "red light–green light" concept are being developed for brigade combat teams. This will allow for immediate action with regard to the protection of personnel and equipment. However, CBRN professionals require higher-fidelity systems that are capable of detecting and identifying chemical warfare agents and toxic industrial materials, detecting biological agents, measuring radiation, identifying isotopes, measuring oxygen levels, detecting lower-explosive limits, and identifying and marking contaminated areas.

The Joint Program Executive Office–Chemical Biological Defense science and technology community is focusing primarily on systems that operate wirelessly and are equipped with sensor and mapping capabilities that support CBRN ground and air missions. While the interface between the sensor, platform, and controller was once facilitated via a tethered (or wired) connection, the new systems use a wireless interface device for communication from the sensor, through a common controller, to the operator. Existing handheld sensors are mounted on standardized platforms. In ground systems, organic CBRN point and standoff detectors (ion mobility spectrometers, photoionization detectors) are mounted on the platform and communication with the operator takes place via sensor feedback and a wireless interface, which are key features of robotics support. The integration of radio frequency with wireless communication permits extended non-line-of-site operations via radio repeater systems, or "bread crumbs." This increases the communication range, allowing adequate distance for standoff operations.

Another key component of the new technology is the platform/payload controller. In conjunction with the Robotic Systems Joint Program Office, efforts are underway to develop the architecture and interface required to permit standardized sensor feedback to the common controller. First, in a one-way mode of operation, the information received on the controller screen appears just as it was presented on the sensor itself. A second effort will involve the addition of two-way communications between the sensor and operator so that the operator can manipulate the sensor (turn the sensor on and off, change the mode of operation).

Robotics requirements are aligned with CBRN capabilities for tactical and homeland defense missions; therefore, robots will become assets for units conducting intelligence, reconnaissance, surveillance, and CBRN missions. For example, the mission of the survey team is to verify the suitability of the area of operations through perimeter monitoring, provide hazard assessment through reconnaissance and site characterization, and collect samples for internal and external laboratory analysis. This involves the detection and identification of chemical, biological, radiological, nuclear, and high-yield explosives and toxic industrial material agents and substances. UGVs and UASs can be used to support these aspects of the survey team mission. Specific tasks that can be performed by UGVs and UASs include—

- Mark and time the route.
- Scan for hazards.
- Conduct air monitoring.
- Check for corrosives.
- Detect radiation, chemical warfare agents, and biological hazards.

In addition, the use of properly equipped UGVs to perform these tasks reduces the thermal load and hazard exposure of a Soldier.

One of the major advantages of robotics is the ability to use a remote or standoff approach to the detection and identification of CBRN hazards. Point sensors are currently employed to provide remote detection and identification capabilities on robotic platforms. With respect to the employment strategy, this provides a form of standoff protection. However, the issue of robot and payload decontamination must be addressed upon mission completion. Based on this and other complications, the development of true standoff detection and identification systems that are capable of providing an alert at some distance outside of the actual contaminated area is preferred. An actual standoff detection capability is especially important for UAS platforms. However, today's standoff sensors are large and cumbersome devices that require extensive miniaturization before they can be integrated on the current platforms.

Following the demise of the Future Combat Systems Program in 2009, the Joint Ground Robotics Integration Team was assembled to fill the void that was created in the area of ground robotic systems development. The Joint Ground Robotics Integration Team, which focuses on the

Talon IV® robot

coordination and development of robotic system platforms of various sizes to support multiple mission profiles, is not a program of record—rather, it is a coordinating body used by all U.S. Army centers of excellence to reduce or eliminate the duplication of effort. The individual centers will develop and provide their own mission payloads that can be tied into the platform interface device. This approach was selected to ensure affordable robotic efforts and achievable results. An additional advantage of this approach is that the various mission payload developers, including the Joint Program Executive Office–Chemical Biological Defense, are not needed to develop platforms; their resources are better focused on areas such as sensor and CBRN-specific support development.

The research and development phase of acquisition is arriving at a point where capabilities can be transitioned into the force as solutions to standoff detection issues and force protection gaps. Interim ad hoc solutions for the rapid development of tactics, techniques, and procedures will become available this year for expected delivery to selected units. Based on tentative plans under discussion at USACBRNS and the Maneuver Support Center of Excellence, they could be delivered as early as next year. While these systems may not be as technologically advanced as the characters portrayed in the science fiction entertainment of the 1970s, they are becoming "smarter" and more autonomous as technology continues to mature.

The Army has demonstrated the operational viability of ground robotics in various mission sets throughout the last decade. But there is a recurring requirement to conduct operations in a safer, more rapid, and more effective manner against a wider spectrum of current and anticipated threats. In response, the Chemical Corps is getting ever closer to employing UGVs and UASs with integrated CBRN sensors to replace human intervention, include higher levels of autonomy, dramatically reduce the risk to personnel, and improve mission effectiveness.

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