When Robots Go to War

Just as the introduction of the airplane rewrote the rules of warfare during World War I, unmanned ground vehicles (UGVs) are changing the shape of the conflicts in Iraq and Afghanistan. Scott Glennon, a senior communications engineer at the MITRE site in Huntsville, Ala., has spent 17 months in Southwest Asia working with American troops to refine what role UGVs should play in various missions. He describes these robotic platforms, which are increasingly used as extensions of human capability, as "one of the indelible changes from these wars."

Two driverless Centaur vehicles like this one were the followers in a leader-follower experiment at Ft. Dix, Trenton, NJ.

"Where is the line between a human controlling a robot's movements and a robot controlling itself?"

"This is the first time that people have been able to see that there are certain tasks we can let a robot do that allow us to protect human lives," says Glennon. "We can disarm a bomb without sending a human being forward with a pair of wire-cutters. If we can neutralize an IED [improvised explosive device] without having to risk a human life, that's important to us. So I don't think you're going to see robot use going away in future wars."

Everybody's Seen R2-D2

As UGVs have become more commonplace on the battlefield, the U.S. military is grappling with the issue of how to use them most effectively. Many people—especially those who grew up watching "Star Wars"—think they already know. In contrast to the skepticism that greeted Gen. Billy Mitchell and others who advocated airpower early in the 20th century, UGVs suffer from excessively grandiose expectations.

"Everybody's seen R2-D2," laments Richard Weatherly, consulting engineer at MITRE's Command and Control Center, who spends a lot of his time just managing expectations. "When airplanes came out, nobody knew what they were about. Robots are new to warfare as well, but everybody assumes they know what they can do."

To help the military better understand the role of UGVs, robotics experts at MITRE have been conducting various tests. In the process, MITRE is positioning itself as a robot systems engineer with a flexible software architecture that can provide the Army with a sound basis for decision making related to UGVs.

The Meteor Rides Again

The current focus has been on teleoperating a "large" (weighing more than a ton) robot using an Army radio to determine what range of functions UGVs can perform based on the current bandwidth of the tactical radios used by the U.S. Army. For one of the first experiments, the MITRE Meteor was transported to Fort Dix, N.J., to gather data. One of three robots that MITRE is using on this project, the Meteor was originally built for the 2005 DARPA Grand Challenge, a 142-mile race across the Mojave Desert sponsored by the Defense Advanced Research Projects Agency (DARPA) to accelerate research and development for autonomous ground vehicles.

Weatherly says the Meteor—a 2005 Ford Explorer Sport Trac—is well suited for the purpose because its size is comparable to large military robots. No less important, the requirements of the DARPA Grand Challenge closely resembled the functions expected of robots in future warfare.

MITRE data indicated that teleoperating a robot is far more challenging than originally thought by the Army. In addition, maximum speeds were lower than expected. So, under those circumstances, where is the line between a human controlling a robot's movements and a robot controlling itself?

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The MITRE team responded by advancing the notion that no such line exists, that human control and robot autonomy are part of a continuum. MITRE engineers suggested letting a robot use its own built-in sensors to detect which object is closest to it and send images of that object back to its human operators.

"We're having an impact on the national defense community by helping them realize that being either autonomous or teleoperated is not a discrete thing," says Weatherly. "Teleoperation can interact with autonomy to help the robot carry out a wider range of functions."

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The MITRE Meteor, a 2004 Ford Explorer Sport Trac, leads two tracked Centaur vehicles in a leader-follower experiment at Ft. Dix, Trenton, NJ.

The Main Challenge

This begs the question: What range of functions should a large robot perform? To help find an answer, Kevin Forbes is helping to develop a centralized controller that will control all of the air and ground-based robots planned by the military. Forbes is MITRE's senior technical advisor for robotics engineering for Future Combat Systems, the Army's principal modernization program. He says the main challenge is transferring the methods of controlling a small robot, which can be started and stopped with minimal impact on its surroundings, to larger vehicles that are harder to control.

"The work we're doing is more focused toward future wars," says Forbes. "There are currently some unmanned platforms out there, but most of them are in the realm of smaller robots. We're working with larger UGVs—vehicles that are truck-size and larger. That's going to be the next generation of unmanned platforms that will be out there, either in a transport role or an actual fighting role."

In Iraq, American and allied troops have used UGVs to find and clear more than 11,000 IEDs since 2006, which has helped to greatly reduce U.S. combat deaths and injuries. Whatever the potential of UGVs in future warfare—and it may be nothing like R2-D2—MITRE's systems engineering expertise, coupled with an information architecture that can accelerate the pace of experimentation, will play an important role in the future of UGVs.

—by Russell Woolard

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