LAND FORCES

Army Still Years Away From Large-Scale Autonomous Ground Vehicle Ops (UPDATED)

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By Jan Tegler

BAE Systems photo

Army efforts to develop and field unmanned ground vehicles capable of taking over a range of battlefield missions have been underway for more than 20 years. But the researchers and companies developing autonomy software and vehicle technologies that will yield safe, effective and lethal robotic ground combat vehicles indicate that large-scale autonomous operations are at least a decade away despite Pentagon prodding to accelerate progress.

"There's this mismatch," Stuart Young, the outgoing manager of the Defense Advanced Research Projects Agency's RACER program, told *National Defense*. "The Army wants [autonomy] cheap, but they don't want to define what they want industry to build for them. That's because the Army doesn't know what it wants to do with autonomy yet. It's a chicken and the egg problem. Industry knows how to build stuff cheap if you can tell them what you want."

RACER, short for Robotic Autonomy in Complex Environments with Resiliency, is a series of experiments DARPA launched in 2020 aimed at driving an autonomous unmanned ground vehicle off-road at combat-relevant speeds. Set to wrap up in March, the program completed its final experiment on Oct. 30, successfully conducting an autonomous breaching exercise at Fort Hood, Texas, with III Armored Corps' 36th Engineer Brigade.

A Textron Ripsaw M5 — modified by DARPA with autonomy software from Overland AI — towed a trailer equipped with a Common Remotely Operated Weapon Station, or CROWS, that fired a rocket-propelled line charge to clear a lane in a minefield. Two soldiers, one equipped with a ruggedized laptop computer employing the autonomy software and a second commanding the weapon, initiated the autonomous M5's drive to the minefield over varied terrain and fired the missile from 2.5 kilometers away.

Maj. Michael Caddigan of the 36th Engineer Brigade said removing combat engineers from the point of breach was the real significance of the DARPA/Army demonstration. Instead of 15 to 20 soldiers executing the inherently dangerous mission up close, two engineers could pull it off from a much safer distance. Caddigan added that the Fort Hood experiment is "by far the most successful and advanced" demonstration of autonomous capability for ground combat vehicles.

The Army's outlook on autonomy for unmanned ground vehicles has shifted repeatedly over the last year. Changes include the cancellation of its Robotic Combat Vehicle program, halting work on its internally developed autonomy suite known as the Robotic Technology Kernel and encouraging industry to present the service with "vehicle agnostic autonomy" options it can choose from.

At the Reagan National Defense Forum in early December, Alex Miller, the Army's chief technology officer, made known the service's intention to reevaluate all current ground vehicle autonomy programs with a potential for cancellation if they "no longer make sense."

John Ferrari, nonresident senior fellow at the American Enterprise Institute, said the Army has pivoted away from trying to guide commercial autonomy providers with heavy-handed requirements, realizing that commercial software will be crucial to faster development of autonomous unmanned ground vehicles.

"The new Army approach is interoperable autonomous software — first in the air, then with the network, then finally with ground vehicles," Ferrari explained.

The new approach recognizes where in the development cycle each of these pieces in the Army's autonomy puzzle currently stand, he added.

"The Army is all-in with a goal of a million air drones," Ferrari continued. "Next is the network, because all of this autonomous stuff has to work together, and this is now where the largest amount of [research, development, test and evaluation funding] is being spent. If you do not get the network right, the autonomous ground fleet will never work."

Lastly comes the least mature technology: ground autonomy, he said.

Young said the Army will do a lot of learning in the next couple years and be able to field some autonomy in limited situations on vehicles that will help grow soldier confidence.

"Ten years from now, we will be forced to have autonomy due to events that happen," he added. "Countermeasures to defeat exquisite solutions are cheap, as the conflict in Ukraine has shown. You've got to come at those cheap solutions with cheap solutions. I think autonomy will increasingly be needed on the battlefield, and that's what will drive wide adoption."

Patrick Acox, vice president of defense growth at Maryland-based autonomy provider Forterra, said he sees autonomous unmanned ground vehicles performing selected missions five years from now.

"Being able to provide protective and offensive fires, being able to send assets out to a forward point and being able to do resupply, I think, are all missions that can be done sooner," Acox said.

"Things like breaching as well — fielded at least at low-rate production — with active units here in the U.S. in five years," he added.

Robotic tank formations and the Armored Multi-Purpose Vehicle are probably in late-stage R&D, he said. "If you look at the scale of that program, you can go do a lot of those support and protective activities for larger capital formations. Ten years from now, I think you get into no-joke autonomous formations going in to do things that people don't inherently do."

BAE Systems' 80,000-pound Armored Multi-Purpose Vehicle is the company's foundational platform for capabilities including autonomy, according to Bill Sheehy, the contractor's ground maneuver product line director.

BAE has partnered with Forterra to develop an autonomy kit for the vehicles already in operation with the Army and for new-build examples.

On contract through 2027, BAE has delivered over 500 AMPVs to date.

Sheehy explained that the company's intent is to be able to apply autonomy kits to the vehicles "as forward as possible" to satisfy the Army's goal of adapting autonomy to existing platforms. Ideally, the kits would be retrofitted to vehicles "within the confines of the Army's motorpools," he said.

"And then if the Army wants to take that kit off, the vehicle has to rapidly return to its original mission profile that it was intended for," he added. "Optionally manned, that's the concept."

But before that can be done, manufacturers will have to design drive-by-wire systems for existing combat vehicles, which currently operate via mechanical controls.

"You can't just bolt on an autonomy kit and make a vehicle autonomous," noted Scott Averitt, manager for advanced capability development and software products at General Dynamics Land Systems.

"You have to reengineer all of the drive and control systems to be drive-by-wire," he said. "That's an additional cost. It's not just a technical problem. How do you make that work financially? You have to buy and adapt the autonomy kit and redesign and integrate all of the control infrastructure to support that."

Young said the Army's desire for optionally manned autonomous ground vehicles is an impediment to their rapid adoption.

"Optionally manned is just code for, 'I'm just going to stick my big toe in this. I don't really want to commit to it,'" he said.

"When you sprinkle autonomy on a vehicle, you start at the wrong spot," Young continued. "If you put autonomy on it, you don't have to put armor on it, because there are no people to protect. And then the prices can come down, and then you can have hundreds of them. Now the revolution is on in terms of how we can use these."

The cost of autonomy is just as important as the speed with which the Army can adopt it, Acox said, pointing out that the Army is simultaneously experimenting with autonomous unmanned ground vehicles in limited numbers while running multiple programs aimed at fielding them.

"From an affordability perspective, I think that [autonomy] is overall decimal dust to a bunch of budgets and being able to move out at scale," he said. "But I would be really curious on the cost of running so many different competitions that sometimes drive back to the same fundamental points. And re-kicking things off over and over again has an inherent expense in and of itself."

The Army will take possession of the four Textron M5s DARPA modified for RACER this spring, Caddigan said. They will be tested further as part of the service's Machine Assisted Rugged Soldier, or MARS, program in a November exercise at the Army's National Training Center at Fort Irwin in California.

Caddigan said combat engineers want to develop a mesh network under the MARS program to allow one soldier to operate multiple autonomous breaching vehicles at once and expand the distance at which they can be operated out to 20 kilometers. Shedding the trailer and putting a CROWS directly on an autonomous vehicle is also a goal.

Aware of the irony that the Army chose RACER vehicles developed by DARPA for high-speed autonomy for one of the service's slowest-moving missions, Young said he would have done a minefield breaching experiment differently. But the Army wanted to do it the way they have always done it, he noted.

"Their first step in putting their big toe in autonomy is, 'can it be useful? Let's do a minefield breach and see if we can do it without people.' That's a logical next extension," he said. "But if I have robots, why don't I just go around that minefield, and I don't have to deal with it?"

Doing so would be a big operational doctrine shift for the Army, Young said.

"And I don't think they're ready to hit that grand slam. They're looking for a solid single." ND

Correction: An earlier version of this story had an incorrect caption and photo credit for the image.

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Re: Army Still Years Away From Large-Scale Autonomous Ground Vehicle Ops

"HDT has been integrating bolt on autonomy solutions for years. Robotic vehicles require an automotive power train and design architecture that is agnostic to mission packages including autonomy. There is a significant distinction between adding autonomy to a manned vehicle and building a robotic vehicle that has the automotive design architecture to accommodate autonomy kits already baked in. From a cost perspective, having a multi-mission robotic ground platform requires design architecture that is agnostic to mission payloads within its weight class. This approach avoids point solutions for numerous capabilities, prevents vendor lock and saves the Army serious developmental dollars. And the US Army's Interoperability Profile (IOP) already defines software and electrical interfaces that enable robots to be agnostic to mission payloads such as autonomy kits. That's the definition of a multi-mission reusable robot."
Tom Van Doren, Ph.D.
President, Robotics Sector

Jorimy Doucet at 2:43 PM

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