



**Why Ground
Robotics are
Now Critical in
Modern Combat**

SITREP

The subject of ground robotics usually brings to mind major programs like: the US Army's XM30, a large weaponized platform replacing the Bradley Fighting Vehicle; or the three Robotic Combat Vehicles in the Next Generation Combat Vehicle program, each weighing in the tonnage; or even US Navy robotics like unmanned underwater vehicles that are autonomous and remotely operated.

At the same time, there's another class of robotic systems that exist today that are programmatic, sustainable, and mature, and playing roles in tactical environments now. Think throwable robots to surveil a bombed-out building, explosives ordnance detection robots with greater autonomy for standoff distance; robotic mules now deployed in the hundreds to take weight burden off soldiers; and autonomous machines for route clearance for maneuver forces.

Robots that perform these functions are now part of the force structure, and becoming more capable through the addition of autonomy and connectedness than they've been since the days they served ground forces during the Afghanistan/Iraq wars

Ground robotics are now again beginning to play a more prominent role due to the amount of ordnance being used in Ukraine and elsewhere around the world. That's fueling the need to create greater standoff distances between warfighters and hazards, and the imperative for better intelligence, surveillance, and reconnaissance .

– *Barry Rosenberg*
Technology & Special Projects Editor
Breaking Defense

If there was ever a manned mission that would benefit from autonomy, then route clearance is it. In mid-2022, a contract was awarded to begin development of the Assault Breacher Vehicle-Remote Control System. (Army photo)





Teledyne FLIR Defense displayed its likely SMET-Inc II competitor, the six-wheeled M2RV, during AUSA 2023. (Breaking Defense photo)

Autonomy in the pursuit of interoperability is today's path for ground robotics

Operation Iraqi Freedom and Operation Enduring Freedom put a narrow focus – a hyper focus even – on robotics platforms, particularly explosive ordnance disposal (EOD) robots that co-starred in the 2010 best picture *The Hurt Locker*. Today's hyper focus is on autonomy and interoperability for multi-domain operations, and the robots of today are now incorporating those capabilities into battle-tested platforms.

"I would step back and tell you that while those wars were winding down, we never stopped iterating and evolving the technologies that EOD operators can have in their toolkit," said Jason Perry, EOD department head for Naval Surface Warfare Center, Indian Head Div. "Tank chassis might not be that much different than what they always have been, but now you've got different effectors with unique capabilities [being integrated]. Robotics is not that much different.

"As we started to look at different payloads that could be attached to robotics platforms, that effort wasn't lost. We've never lost sight of the fact that the threat is evolving from OIF/OEF to Great Power competition and we're making sure that we observe the threats that are out there."

NSWC IHD is a Navy Manufacturing Technology Center for Energetics, one of seven Centers of Excellence established by the Office of Naval Research's ManTech Program. In late 2021, the Secretary of the Navy was designated as the DoD-wide executive agent for EOD, technology, and training.

In discussing ground robotics, Perry spoke in broader terms of how autonomy is changing these systems across naval, ground, and air domains, in particular, all of which are becoming increasingly populated with drones.

It's about using artificial intelligence and machine learning to create a capability for ground systems that works like the Siri digital assistant. When you tell Siri to make a call it does. Likewise, autonomy will move to where a Siri-like digital assistant for robots can be told to discharge the robot from its containment and the machine drives itself out.

What that autonomy does is create interoperability, and that's where the connection lies between ground robotics and Joint All Domain Command and Control and multi-domain operations. Perry pointed out that we're not talking about "all" domain operation as the space domain isn't hospitable, yet, to drones and autonomous craft.

"The biggest thing from my seat here at the Technology Center and the joint realm is interoperability," said Perry. "It's multi-domain manned/unmanned teaming. There's certain domains that each of the services are uniquely looking at [for] commonality, and we at the tech center want to ensure that they're interoperable.

"If the Navy gets marching orders to focus more on X maritime robotic platform, will that mesh with bigger Navy, bigger JADC2, bigger whatever the direction is? The other

reality is autonomous systems have proliferated across the service to multiple different communities, so it's vitally important that they do not step on each other when you're navigating in the battlespace."

And what technologies/capabilities will make that possible over the next decade?

"In my opinion, it looks very much like a mesh network of capabilities that [gives] somebody visibility on what is occurring across the battlespace, across that domain," said Perry. "That information is speeding up a decision cycle – whether that's the decision for an EOD technician, for a route clearance commander, for an infantry platoon, or for the regimental commander. Ultimately the end state is using unmanned teaming to pose a credible threat in the battlespace and inform the commander so that they can make a decision faster."

Army robotics roll on

Ground robotics are now again moving to play a more prominent role due to the amount of ordnance being used in various conflicts around the world, along with complementary needs for robots dedicated to missions such as logistics and supply to keep troops equipped, fed, and properly supplied.

One such machine is the eight-wheel Small Multipurpose Equipment Transport Increment I (S-MET Inc I), which is currently filling the Army's mule role for dismounted soldiers, squads, and small units. With a payload capacity of 2,500 pounds, which the Army says takes about 100 pounds off the back of a dismounted soldier, S-MET can drive about 60 miles in 72 hours – generating along the way three kilowatts of power while stationary and one kilowatt rolling to continually recharge batteries and other systems while on the move.

It's controlled by a single-hand controller that can be wireless/remote or tethered, giving soldiers flexibility so they can operate at standoff distances when working in contested, combat environments.

Management of S-MET falls under US Army Program Executive Office Combat Support & Combat Service Support (CS&CSS), Product Manager Robotic and Autonomous Systems (PdM RAS), which has been fielding the ground drone since late 2020 under a Middle Tier of Acquisition Rapid Fielding authority. To date, the Army has fielded 284 of the required 624 systems, with deliveries slated for completion in October 2024, according to CS&CSS.

"The baseline program, so far, [is] going well," said Doug Bush, assistant secretary of the Army for Acquisition, Logistics and



Navy explosive ordnance disposal technicians locate and attach a towing cable to a training mine during a mine countermeasures drill in April 2023. (US Navy photo)

Technology, at the Association for the United States Army conference in October. "It's a building block. What else can you do with that chassis? Weapons? Sensors?"

The answer(s) to that question will be explored during the development of S-MET Increment II. The Army approved its Capability Development Document in August 2023.

"The S-MET Inc II will provide enhanced capability primarily in infantry Brigade Combat Teams, explosive ordnance disposal, and security force assistance brigades," said Kent Shea, product manager, Robotic and Autonomous Systems, CS&CSS.

"S-MET Inc II will have increased capabilities for kinetic, cyber, and electromagnetic survivability, and will be adaptable for modular mission payloads.

"S-MET Inc II will provide the capability to reduce soldier physical burdens in anticipated terrains and environments, while simultaneously providing power-generation needed for extended mission durations."

The Army plans to release a competitive Request for Prototype Proposal in 1QFY24 for Increment II to develop next-generation systems to meet the Army Acquisition Objective of up to 2,195 systems.

Autonomy for legacy ground systems

Army PdM RAS is also working to bring autonomy to legacy ground systems, such as the Army M1150 Assault Breacher Vehicle (ABV) for route clearance and obstacle breaching. There have been recent news reports that the M1150 has been seen in Ukraine.

With a crew of two, this mine- and explosives-clearing vehicle consists of an M1A1 Abrams tank hull and a unique turret that forges a tank-wide cleared lane through a minefield by



The Kobra 725 UGV can integrate and deploy a large range of accessories for EOD, CBRN/HazMat, breaching, and other applications. (Teledyne FLIR photo)

launching and detonating one of its two Mine Clearing Line Charges across the minefield. It then proofs the lane with its plow and marks the cleared lane.

If there was ever a manned mission that would benefit from autonomy, then route clearance is it. In mid-2022, a contract was awarded to begin development of the Assault Breacher Vehicle-Remote Control System (ABV-RCS) in support of robotic breach with standoff capability.

“It will allow remote operators to control automotive functions, front-end equipment, and other ABV subsystems such as lane marking, demolition charge, and self-obscurants,” said Shea.

“Operators will receive visual, auditory, and haptic [touch] feedback.

“The ABV-RCS program is utilizing an Other Transaction Agreement [and] prototypes are expected to be completed and delivered in 2QFY24 to support the start of prototype testing.”

In addition to the ABV-RCS, PdM RAS shared updates on several other robotic programs in its portfolio.

Common Robotic System – Individual (CRS-I): Small sized at less than 25 pounds with various mission payloads, this soldier back-packable, remotely operated, robotic system supports EOD and engineer units. It utilizes both radio and tethered communications for dismounted soldiers to keep a standoff distance from hazards. CRS-I remains in production and will continue to field through FY24. There are currently 1,093 systems fielded out of 1,759 required as of October 2023.

Man-Transportable Robotic System Increment II (MTRS Inc II): Medium sized at under 164 pounds, this soldier transportable, remotely operated, robotic system supports EOD, chemical, biological, radiological, nuclear (CBRN), and engineer units. It has capabilities to clear obstacles and threats for maneuver forces. Warfighters can remotely detect, neutralize, clear, sample, quantify, identify and dispose of hazardous threats. MTRS Inc II remains in production and will continue to field through FY24. There are currently 745 systems fielded (out of 1,200 required) as of October 2023.

Common Robotic System – Heavy (CRS-H): Vehicle transportable at under 700 pounds, this robotic platform accepts various mission payloads and provides increased standoff capability to identify, render safe, and dispose of explosive ordnance and improvised explosive devices. CRS-H completed its fielding of all 128 systems in September 2023.

Threat scenarios where ground robotics are relevant

Ground robotics are more relevant in today's environment than they ever have been before, including for use in the Great Power competition and multi-domain operations. This can mostly be attributed to advances in technology and organizational maturity, as well as adoption of robots into standard operating procedures. Potential scenarios for use stretch from benign applications to more dynamic environments. Some of these scenarios include the following categories.

COUNTERTERRORISM AND COUNTERINSURGENCY:

Ground robots can be used for tasks like reconnaissance, surveillance, and explosive ordnance disposal in counterterrorism and counterinsurgency operations. They can help reduce the risk to human personnel and gather critical intelligence.

SEARCH AND RESCUE: In disaster-stricken areas or during search and rescue missions, ground robots can navigate hazardous environments, locate survivors, and provide real-time information to rescue teams.

ROUTE CLEARANCE: Ground robots equipped with specialized sensors and tools can clear landmines and unexploded ordnance, helping to make areas safe for civilian populations and troop movements.

LOGISTICS AND SUPPLY: Autonomous ground vehicles can be used to transport supplies and equipment to remote or dangerous areas, reducing the risk to human drivers.

EXPLOSIVES ORDNANCE DISPOSAL: Remotely operated systems provide standoff capability to detect and identify hazards like improvised explosive devices, unexploded ordnance and landmines that threaten maneuvering forces and civilians.

SURVEILLANCE AND RECONNAISSANCE: Ground robots equipped with advanced sensors and cameras can gather valuable intelligence in contested or hostile environments.

URBAN WARFARE: In dense urban environments, ground robots can provide support to infantry by breaching obstacles, providing cover fire, and conducting reconnaissance without exposing human soldiers to excessive risk.

CRITICAL INFRASTRUCTURE PROTECTION: Robots can be used to patrol and protect critical infrastructure such as power plants, dams, and transportation hubs from potential threats, as well as monitor for potential failures, providing early warning through constant inspection.

CHEMICAL, BIOLOGICAL, RADIOLOGICAL, NUCLEAR (CBRN) THREATS: Ground robots can be employed to detect and handle hazardous materials in CBRN scenarios, reducing the risk to first responders.

ANTI-ACCESS/AREA DENIAL (A2/AD) ENVIRONMENTS:

In situations where near-peer adversaries like China employ A2/AD strategies to limit access to certain areas, ground robots can be used to gather information, conduct reconnaissance, and perform various missions while reducing the risk to human forces.

BORDER SECURITY: Autonomous or remotely operated ground robots can patrol and monitor borders to detect illegal crossings, smuggling activities, or security breaches.

ESCALATION CONTROL: Ground robots can potentially help reduce the risk of unintended escalation in conflict situations by providing a less provocative presence compared to manned military assets.

CIVIL UNREST AND LAW ENFORCEMENT: Law enforcement agencies can use ground robots for crowd control, riot monitoring, and surveillance in situations of civil unrest.

ALWAYS RELEVANT, GROUND ROBOTICS LOOK TO EXPAND BEYOND EOD AND HAZMAT/CBRN

In this Q&A with Teledyne FLIR on unmanned ground systems (UGS), we discuss the state of robotics today and how platforms already integrated into the force can evolve for new missions, with: Tung Ng, vice president, UGS; David Viens, vice president, US Business Development – Defense; and Nate Winn, senior product manager, UGS.

Breaking Defense: What's the state of ground robotics today? You say that programmatic, sustainable and mature ground robotic systems exist today and are ready for application now in numerous scenarios. Explain.

The DoD has been programmatically selecting and fielding ground robotic systems to satisfy capability requirements in some cases for 20 years. To date, the main focus has been on using unmanned systems for route clearance missions, explosive ordnance disposal (EOD) as a means of providing standoff distance while disposing of dangerous devices, and for monitoring of chemical, biological, radiological, and nuclear (CBRN) threats.

Because of this focus, the engineering, EOD, and HazMat/CBRN communities are the most mature in their integration of robots into their force structure, having fielded thousands of robotic systems throughout the DoD over the last 20 years in these communities alone.

We believe that the most prudent method for other communities that do not currently have robots integrated into their force structure and SOPs (standard operating procedures) is to look across the fielded systems that are already in use in the services and use them as a baseline for capability development. The benefit of this approach is access to programmatically supported systems that are quick to 'turn on' as they have already received the certifications needed to be used by US military personnel.

Things like cyber security, authorization to operate, and ATEC safety certifications can take a massive effort to accomplish. While waiting for new requirements and development and certification of novel systems, it makes sense to adopt currently available systems now in order to refine and mature a solution for tomorrow.

Breaking Defense: What is happening in Ukraine with unexploded ordnance is similar to what happened in other wars. That calls for a need of having robots both during and after a conflict. Explain.

There hasn't been much of a push for ground robots in Ukraine for route clearance and EOD to date, but there

are thousands of unexploded ordnance that are not being addressed and mine fields preventing rapid offensive movement. There was a recent news article about Ukrainians having to dismount their tanks and advance past a minefield on foot.

What we're primarily hearing about robots in this conflict is that the EOD mission will be part of the post-conflict clean up effort. However, these dangers are present today and robots can help improve the safety posture, speed of movement, and offensive capabilities of the men and women employing them like US troops did in Iraq and Afghanistan.

Breaking Defense: Robots like PackBot, FirstLook, and Kobra are already being used across Europe by countries providing various donations and training to Ukraine. Describe how these robots could provide support to Ukraine now and in the future.

These robots could be used to accomplish reconnaissance tasks by using onboard optics, provide a means to accomplish route clearance and EOD tasks, and can be outfitted with CBRN sensors to monitor for the use of relevant threats.

In addition, the Kobra can be used to remotely CASEVAC (casualty evacuation) for wounded persons, and each of the systems can be weaponized.

Breaking Defense: Describe your family of robots.

FirstLook® is a lightweight, throwable robot that can quickly navigate through tight spaces and hazardous areas. With its compact design and advanced sensor technology, FirstLook is ideal for rapid reconnaissance and surveillance, allowing operations where other robots can't fit or maneuver and providing critical intelligence in real-time. This rugged, lightweight robot can be inserted into structures and provides operators with visual, audio, and sensor feedback before entry. FirstLook can navigate obstacles, crawl through pipes and tunnels, turn in place and self-right when flipped over. Quick to power-up, FirstLook can be deployed in a moment's notice.

SUGV is a rugged, dexterous, and expandable solution for operators on the move. Able to be back-packed into dangerous situations, deployed by one person in confined spaces and independent of large vehicles or personnel carriers, the SUGV enters, evaluates or mitigates hazardous situations, providing invaluable situational awareness for all mobile personnel. It is optimized for dismounted, mobile and multi-mission operations. Weighing approximately 29.4 lbs (with manipulator) SUGV is capable of max speeds over 6 mph and turns-in-place to enable operation and controlled movement in confined space. SUGV is equipped with a rugged manipulator capable of lifting 12 lb fully extended or 22 lb close-in and accommodates an expanding array of payloads and disruptors.

PackBot® 525 is a rugged, portable, medium sized robot that can be deployed in any hazardous environment and is flexible enough to accomplish any mission. It can lift up to 44 lbs (20 kg), runs for over eight hours, and stows neatly in a vehicle, even fitting in a car's trunk. If conducting bomb disposal operations, reconnaissance missions, or disaster response efforts, PackBot can navigate through debris, climb stairs, and traverse rough terrain with ease. Its advanced sensor technology provides real-time High-Definition video for situational awareness, allowing operators to stay safe while completing complex tasks.

The Centaur® product line supports remote monitoring, debris removal, route clearance, casualty evacuation, inspection, and reconnaissance applications. Centaur is the solution to the U.S. Army's Man Transportable Robotic System Increment II (MTRS Inc II) program of record. Based upon field-proven technology, Centaur remotely operated

systems are compatible with CBRN and explosives detection payloads for stand-off capability to detect, confirm, and identify hazards like landmines, unexploded ordnance, and improvised explosive devices in the path of maneuvering forces. Centaur can be deployed from a mounted or dismounted location while keeping the operator at a safe distance.

Kobra™ 725 combined strength, power, and payload support in a highly maneuverable platform in rough terrain. The robot is able to climb stairs, reach over 11 feet in the air, and stow into tight spaces for transportation. The state-of-the-art, UGV Interoperability Profile-compliant system allows for future third-party payload expansion. Kobra 725 can integrate and deploy a large range of accessories for EOD, CBRN/HazMat, breaching, and other applications. Weighing in at about 500 pounds (227 kg), the Kobra is capable of taking on the biggest jobs our customers have. And, with a runtime of 10-hours, this system can persist on scene without interruption.

Breaking Defense: Final thoughts?

The number of ground robots throughout DoD is at an all time high, but adoption throughout certain communities is higher than others. We believe that the benefits of ground robots are just starting to be realized beyond traditional EOD, route Clearance, cBRN uses.

We are excited for the future and are investing and innovating to ensure we are always leading the way by delivering useful, rugged robots that keep distance between good people and bad things.



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