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Maneuver Robotics and Autonomous Systems: Enhancing Tactical Maneuver

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During the 2017 U.S. Army Maneuver Warfare Conference, the commanding general (CG) of the Maneuver Center of Excellence (MCOE) asked who among the audience had any boxing experience. An officer raised his hand, and the CG asked him to share one of the most important factors that a boxer must consider when studying an opponent. The officer replied "reach." The CG concurred, affirming that the boxer with greater reach has standoff, can strike first and has more options.[1] This exchange underscores the Army's intent to transform and extend its "reach" in the land warfare domain to regain tactical overmatch against near-peer adversaries.

Recognizing the decades-long dominance of U.S. land forces in the conventional close fight as demonstrated in Operation Desert Storm in 1991, near-peer adversaries have embraced evolving technologies and tactics in pursuit of tactical standoff against these formations.[2] In the more than 17 years since 9/11, the U.S. Army has been heavily focused on waging counterinsurgency and counterterrorism campaigns against low-tech but lethal forces.

During this timeframe, near-peer competitors have developed capabilities with the potential to degrade the U.S. advantage in close combat by disrupting U.S. forces before they can close with and destroy them. The U.S. Army is seeking to counter adversary standoff by addressing critical capability gaps and through the conduct of multi-domain operations that involve, in part, the use of robotics. The use of maneuver robotics and autonomous systems (MRAS) can increase the reach of U.S. Army forces from the battalion to the squad levels and addresses the threats of a more lethal battlefield enabled by technologies that are employed by near-peer competitors.

Near-Peer Threats and the U.S. Army's Response

In 2014, during the Ukrainian revolution, Russian ground forces and Ukrainian separatists launched a devastating rocket artillery attack that annihilated two Ukrainian armor battalions in Zellenopillya (in the Luhansk region, near the Russian–Ukrainian border) in just over three minutes. Hours earlier, Russian unmanned aerial vehicles (UAVs) and cyber reconnaissance

ISSUE

The U.S. Army needs to leverage capabilities provided by maneuver robotic and autonomous systems (MRAS) to overcome tactical overmatch by near-peer adversaries in the close fight.

SPOTLIGHT SCOPE

- Highlights implications of emerging Russian New Generation Warfare Study.
- Addresses U.S. Army approach toward closing several capability gaps:
  - #11—Conduct air-ground reconnaissance and security operations;
  - #15—conduct joint combined arms maneuver; and
  - #20—develop capable formations.
- Describes initial lessons learned from exercises and experiments with MRAS that contribute to increased survivability and lethality.

INSIGHTS

- MRAS will be essential to defeating near-peer adversaries seeking to exploit potential U.S. Army capability gaps.
- To achieve overmatch, the Army will use MRAS and manned/unmanned teaming (MUM-T) to provide the joint force commander with additional capability to present enemies with multiple dilemmas.
- The Army is experimenting with robotic combat vehicles to enhance mobility, lethality, protection and semi-independent maneuver from battalion to squad level.

An M58 Wolf is remotely controlled to release a cloud of smoke during a Robotic Complex Breach Concept demonstration at Grafenwoehr Training Area, Germany, 6 April 2018. The Robotic Complex Breach Concept employed the use of RAS in intelligence, suppression, obscuration and reduction missions (U.S. Army photo by Specialist Hubert D. Delany III/22nd Mobile Public Affairs Detachment).

had located the Ukrainian armored column's position.[3] The sophistication with which the Russian ground forces and Ukrainian separatists employed an effective sensor-to-shooter network, integrating tools from multiple domains, demonstrated a marked improvement in Russian military capabilities, illustrating Russia's potential for achieving tactical overmatch against the U.S. military.

Integration of unmanned aerial systems (UAS), unmanned ground systems (UGS), special operations forces and equipped militia to enhance sensor-to-shooter networks have resulted in an improved Russian land force capability that potentially overmatches the Army's tactical formations.[4] According to the Army's 2016 Russian New Generation Warfare Study, the goal of this integration is to enhance the reach and precision of attacks to degrade an opponent's ground combat strength as it engages in the tactical close fight.

Army brigade combat teams (BCTs) lack the range, protection and reach that Russian ground forces possess; they could be overmatched should hostilities occur in the near term. The Army, through its Training and Doctrine Command, is addressing this shortfall by assessing lessons learned from the study and analyzing them in light of Army Warfighting Challenges. The three challenges most relevant to this issue are: (11) Conduct air-ground reconnaissance and security operations; (15) conduct joint combined arms maneuver; and (20) develop capable formations.[5]

The assessment demonstrated the need for U.S. ground forces to increase time, space, protection, range, mobility and lethality to overmatch an adversary with similar capabilities. The doctrinal solution consists of operations conducted across multiple fighting domains (sea, air, land, space and cyber/electronic warfare), as described in *Field Manual 3-0: Operations* and in *The U.S. Army in the Multi-Domain Operations, 2028*.[6] Autonomy-enabled systems can serve as force multipliers at all echelons from squads to BCTs by enhancing situational awareness, mobility and speed of action.

Maneuver Robotics and Autonomous Systems (MRAS)

In 2017, the Army published a robotics and autonomous systems strategy (RAS) that, when implemented, will increase survivability by providing greater standoff distance from enemy fires and place fewer Soldiers at risk during dispersed maneuver or convoy operations. It established five capability objectives for semi-autonomous/autonomous systems: (1) Increase situational awareness; (2) lighten Soldiers' physical and cognitive workloads; (3) sustain the force; (4) facilitate movement and maneuver; and (5) protect the force.[7]

One of the key components necessary to execute this strategy is MRAS. Its key technologies enhance movement and maneuver and extend tactical reach as units operate in mobile and dispersed formations, mitigating the effects of enemy standoff fires (including artillery, mortars, anti-tank guided missiles and drones).

[1] Eric J. Wesley, "The OE & AFC-MM," speech at the Maneuver Warfare Conference, Fort Benning, GA, 12 September 2017.

[2] Valery Gerasimov, "The Value of Science Is in the Foresight: New Challenges Demand Rethinking the Forms and Methods of Carrying Out Combat Operations," *Military Review*, January/February 2016, 24–29.

[3] Amos C. Fox, "Battle of Debal'tseve: The Conventional Line of Effort in Russia's Hybrid War in Ukraine," *ARMOUR: Mounted Maneuver Journal*, Winter 2017, 50–51, http://www.benning.army.mil/armor/earmor/content/issues/2017/winter/armor_winter_2017_edition.pdf.

[4] Army Capabilities and Integration Center (ARCIC), "Army War-Fighting Challenges," 2017, http://www.arcic.army.mil/initiatives/armywarfightingchallenges.

[5] ARCIC, "Army War-Fighting Challenges."

[6] ARCIC: Maneuver, Aviation and Soldier Division, "Robotics and Autonomous Systems Strategy," March 2017, 1, 2, 20, http://www.arcic.army.mil/app_documents/ras_strategy.pdf.

[7] Vivienne Machi, "Armed Robots Fight Alongside Soldiers at National Guard Exercise," *National Defense Magazine*, August 2017, http://www.nationaldefensemagazine.org/articles/2017/8/31/tardec-wingman-capability-on-display-at-northern-strike.

According to the strategy, the use of MRAS in teamed formations can enhance lethality, situational awareness, force protection, survivability and mobility. Soldiers and robotic vehicles work together to protect the force, identify the enemy and engage when necessary. This synchronization between Soldiers and unmanned platforms is described as Ground Manned–Unmanned Teaming (MUM-T).[8] Ground MUM-T envisions UAVs and UGSs working in support of Soldiers to extend their mobility and penetrate a denied environment.

Top leaders from the Army gather for an MRAS live fire demonstration at Fort Benning, Georgia, on 22 August 2017. The Capabilities Development and Integration Directorate of the MCOE and Fort Benning hosted an RAS industry day at the MCOE headquarters on 30 August 2018 (U.S. Army photo by Patrick Albright, MCOE, Fort Benning Public Affairs).

Training and Experimentation

The Army is using training exercises to inform its plans about MRAS employment to enhance lethality, situational awareness, force protection and survivability. From simple UAS to terrain-challenged UGS, these developing technologies are part of a test and evaluation process that supports development of tactics, techniques and procedures for Soldiers to employ with robotic partners.

In June 2017, the Michigan National Guard participated in Exercise Northern Strike at Camp Grayling to experiment with emerging tactics employing autonomous systems. The Army's Tank Automotive Research, Development and Engineering Center (TARDEC) and Armament Research, Development and Engineering Center (ARDEC) partnered to employ robotic systems to assist Soldiers in the field.[9] TARDEC served as the lead system integrator and mobility provider, and ARDEC served as the lethality lead.

A squad employed a remote reconnaissance vehicle with a tethered hover UAV and an unmanned M113 personnel carrier outfitted with a remote M240 machine gun for support. This enabled the squad to engage the enemy from a protected position, demonstrating the potential for equipping units with armed robotic partners to increase range, reach and situational awareness and decrease risk.

Although it was the first Army exercise to pair humans and shooting ground robots, it was not the first time that an armed robot has been sent out to work next to Soldiers. Shortly after the United States invaded Iraq in 2003, units deployed a mini-tank bot called SWORDS (Special Weapons Observation Reconnaissance Detection System) that allowed a Soldier to remotely direct the bot to fire a mounted, crew-served weapon.

During the MRAS demonstration at Fort Benning, Georgia, in August 2017, the Maneuver Center of Excellence (MCOE) tested integration of UAS and UGS to enhance combat vehicle lethality. TARDEC and ARDEC paired manned and unmanned vehicles in a simulated attack. In the TARDEC demonstration, manned and unmanned high-mobility, multi-purpose wheeled vehicles (HMMWVs) paired with an unmanned light reconnaissance vehicle, conducted reconnaissance with smaller tethered vehicles and attacked a target. The demonstration showed the practical use of MUM-T in that it limited the risk of exposure of the manned tanks and HMMWVs to lethal fires. During ARDEC's Abrams Lethality Enabler demonstration, one unmanned vehicle provided a smokescreen for the tanks while a second

RAS CAPABILITY OBJECTIVES

- Increase situational awareness;
- lighten soldiers' physical and cognitive workloads;
- sustain the force;
- facilitate movement and maneuver; and
- protect the force.

[8] Major John Dickson and Jillyn Alban, "On Northern Strike Exercise 2017," email message to author, 27 September 2017.

[9] Jen Judson, "U.S. Army Tackles Teaming Robots and Ground Forces on Battlefield," *Defense News*, 25 August 2017, https://www.defensenews.com/land/2017/08/25/us-army-tackles-teaming-robots-and-ground-forces-on-battlefield.

A remote controlled D7R-II dozer removes rubble to create an open lane for vehicles during experimental testing at the Caterpillar Edwards Demonstration and Learning Center in Edwards, Illinois, on 25 October 2018 (U.S. Army Photo by Sergeant 1st Class Jason Proseus/416th TEC).

MFMS CRITICAL ENABLING TECHNOLOGIES

- Directed energy and energetics;
- power generation and management;
- advanced armor materiel solutions;
- vehicle protection suite; and
- MRAS.

unmanned vehicle fired its long-range mortar. The tank crew controlled both unmanned vehicles from its protected reverse slope location.[10]

The importance of MRAS is demonstrated by the Army's analysis of the outcomes of these experiments. This has been precipitated by the development of a modernization strategy to provide a pathway to the future maneuver force enabled by MRAS. This strategy— the maneuver force modernization strategy (MFMS)—has established a requirement to develop the Next-Generation Combat Vehicle that can leverage five critical enabling technologies. Ultimately, MRAS is informing science and technology efforts, capabilities development and investment in robotics in the battlefield.[11]

The Way Ahead

The Army plans to test the reach provided by MRAS over three timeframes: (1) near-term (current–2020); (2) mid-term (2021–2030); and (3) far-term (2031–2040). Newer technologies, maintenance solutions and better weapon systems are likely to emerge during these periods. Potential advantages, among others, may include: extending sensor range; capitalizing on system-specific efficiencies (e.g., the UAS is quieter with greater loiter time, but the manned system carries more firepower); enhanced survivability; target engagements at longer stand-off ranges; and better actionable intelligence for commanders and pilots.[12]

Conclusion

Regaining tactical overmatch against near-pear adversaries is an imperative. MRAS, with both current and leap-ahead technologies, can mitigate adversaries' advantages by enhancing reach, range, dispersion, mobility, maneuver, lethality and protection for friendly Soldiers.

To achieve overmatch, the Army will use MRAS and MUM-T to provide joint force commanders with enhanced capabilities to operate across all domains and present enemies with multiple dilemmas. MRAS, by exploiting breakthroughs in technology applied to maneuver, will be a key contributor to how U.S. ground forces will fight and win future conflicts.

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[10] William Nuckols and Ted Maciuba, "On MRAS and Ground Manned-Unmanned Teaming," email message to author, 9 January 2018.

[11] U.S. Army Training and Doctrine Command, "Maneuver Force Modernization Strategy," Maneuver Center of Excellence, Fort Benning, GA, 16, https://tradocnews.org/tag/maneuver-force-modernization-strategy/; Sydney J. Freedberg, Jr., "Army Wants 70 Self-Driving Supply Trucks By 2020," *Breaking Defense*, 20 August 2018, https://breakingdefense.com/2018/08/army-wants-70-self-driving-supply-trucks-by-2020/.

[12] Matthew Cox, "Army Unveils Family of Future Vertical Lift Helicopters," *Military.Com: Defense Tech*, 27 March 2018, https://www.military.com/defensetech/2018/03/27/army-unveils-family-future-vertical-lift-helicopters.html.