The Future of Autonomous Weapons Systems: A Domain-Specific Analysis

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SINCE DEPARTMENT OF DEFENSE DIRECTIVE 3000.09 on autonomy in weapon systems was signed in 2012, it has failed to generate consensus on the definition of "autonomy" or make progress to regulate autonomous weapon systems (AWS). With the directive set to expire at the end of 2017, the Department of Defense has an opportunity to clearly chart a course for the future of AWS.

Rather than relying on imprecise phrases like "appropriate level of human judgment in the use of force," DoD should outline domain-specific applications of autonomous technology to clarify how AWS will be used. While U.S. allies like Britain have recently ruled out pursuing fully autonomous weapons, adversaries like Russia and China are heavily investing in and integrating these technologies. The proliferation of autonomous technology from adversaries and in the commercial sector will require the United States to add AWS to its forces. Ultimately, AWS must be integrated across domains, but for now, domain-specific analysis can dispel the counterproductive fears peddled by the technology's opponents and demonstrate the potential of AWS to change warfare.

Referred to by opponents as "killer robots," AWS have been branded to make casual sci-fi fans tremble at the possibility of their television nightmares coming to life.[1] The AWS emerging in battlespaces today, however, more resemble unmanned versions of recognizable platforms like tanks, airplanes, and submarines.[2] For the current discussion, an AWS will be defined as a system that, once activated, identifies and engages targets without using preprogrammed instructions and requiring no further human input.[3] AWS operate in unique physical spaces that affect how the technology engages combatants. The characteristics of a domain should be used to frame the discussion of how and whether emerging technology abides by the international law of armed conflict.

Unmanned Aerial Vehicles and Autonomous Swarms

While most people are familiar with large military unmanned aerial vehicles (UAVs) like the MQ-9 Reaper and MQ-1 Predator, smaller systems are often overlooked and undervalued. Large UAVs are vulnerable to even

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moderate air defenses, which is why they are most successful when deployed in asymmetric conflicts where adversaries lack air defenses. In addition to performing intelligence, surveillance, and reconnaissance (ISR) missions, small autonomous UAVs operating as "swarms" will be capable of penetrating environments defended by more advanced technology. By saturating the airspace with many targets, swarms mitigate the effectiveness of air defense, and could be used in ordnance delivery against targets that are well defended. Converting models like the Israeli Harpy, which target radar systems, into AWS that can reliably strike other soft military targets would help address issues presented by advanced defenses.[4]

Some might worry, however, that greater penetration of air defenses brings lethal AWS into close proximity to combatants and noncombatants. Whereas high-flying large military UAVs are wrongfully criticized for being detached from the battlespace, future systems may be condemned for the exact opposite reason. Yet, the fear elicited by AWS operating in populated areas must not be allowed to paralyze policy development. As Benjamin Wittes argued in 2012, it is entirely possible that in some environments AWS might "distinguish military targets far better and more accurately than humans can."[5]

Unmanned Ground Vehicles, First on the Shore, First through the Door

Unmanned ground vehicles (UGVs) have already demonstrated their utility in the land domain for several tasks, including the removal of IEDs, and are being prepared to take on even more offensive roles. In ship-to-shore exercises in April 2017, the Marine Corps Warfighting Lab showed how two Multi-Utility Tactical Transport (MUTT) robots and a Weaponized Autonomous System Prototype (WASP) could substitute for marine forces as the first units to storm an enemy's shore. Commenting on the exercise, Col. Daniel Sullivan, deputy commander of the warfighting lab, said, "going forward, the first one in the room should never be an air breather. It should be a robot with a lethal capability, [and] it's the same thing coming ashore."[6]

As dual-use autonomous capabilities are developed commercially and by adversaries, U.S. and allied warfighters will be put under the cognitive strain of fighting at machine speed.[7] As with soldiers, a UGV's ability to abide by the law of armed conflict may be mitigated in confined spaces where combatants and civilians are mixed. Whereas UAVs can loiter and evaluate targets from above,

UGVs are afforded less time to make targeting decisions. The close spatial and temporal relationship between UGVs and combatants warrants a higher degree of scrutiny on their use and on the algorithms that guide their actions. This especially true when compared to systems operating in less populated environments, like in the naval domain.

Unmanned Undersea Vehicles as the Future Leg of the Nuclear Triad

The revolutionary impact autonomous unmanned undersea vehicles (UUVs) will have on maritime warfare is hard to overstate. Large and Extra Large Displacement Unmanned Undersea Vehicles (LDUUV and XLDUUV), like the Echo Voyager, will be designed to perform below-water ISR, clandestinely deliver mines, and launch precision-guided weapons. Additionally, UUV swarms of small long-endurance drones could perform dangerous below-water ISR in littoral waters and in surface missions.[8]

Because UUVs operate in the vast sea domain, there is more certainty that the weapon can safely identify and engage solely military targets. Additionally, leveraging autonomous capabilities underwater will have dramatic effects on strategic posture, especially as states like North Korea and Iran continue to develop nuclear weapons.[9] UUVs armed with strategic weapons, like manned submarines before them, project power in dangerous and denied environments, extending U.S. military capabilities. While some U.S. officials hesitate, the Russian Navy has reportedly already tested a nuclear-capable UUV designed to spread radioactive contamination along enemy coastal areas "rendering them unusable for military, economic, and other activity for a long time."[10] Although an autonomous nuclear-armed submarine is not likely to be deployed in the immediate future, the need to hedge against such a threatening capability is clear.[11]

Conclusion

The United States' adversaries are vigorously developing AWS, threatening to eclipse the United States and its allies in a future world that will be dominated by these emerging technologies. While overarching regulation may be premature, it is important the Department of Defense continues to think critically about the legal and strategic implications of AWS. As then-deputy secretary of defense Bob Work outlined in the Third Offset Strategy in April 2016, AWS will only continue to grow in importance and play a key role in future multidomain battle. Thinking creatively about how the physical space in which autonomous systems operate affects their use in combat can provide a framework for future doctrine and regulation of autonomous systems.

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Endnotes

1 "The Latest Nightmare Inducing Boston Dynamics Robots," YouTube Video, 8:15, January 31, 2017, https://www.youtube.com/watch?v=-h5qpXO3isM&feature=youtu.be&t=3m45s.

2 Directive 3000.09 does not cover "autonomous or semi-autonomous cyberspace systems for cyber operations." See Department of Defense, "Autonomy in Weapon Systems," DOD Directive 3000.09, November 21, 2012, 2b.

3 Paul Scharre and Michael Horowitz, "An Introduction to Autonomy in Weapon Systems," Center for a New American Security, February 2015, https://www.cnas.org/publications/reports/an-introduction-to-autonomy-in-weapon-systems.

4 Kelsey D. Atherton, "The Pentagon's new drone swarm heralds a future of autonomous war machines," *Popular Science*, January 10, 2017, http://www.popsci.com/pentagon-drone-swarm-autonomous-war-machines.

5 Benjamin Wittes, "Does Human Rights Watch Prefer Disproportionate and Indiscriminate Humans to Discriminating and Proportional Robots?," *Lawfare*, December 1, 2012, https://www.lawfareblog.com/does-human-rights-watch-prefer-disproportionate-and-indiscriminate-humans-discriminating-and.

6 Patrick Tucker, "Marines 'The First One Through the Door Should Be a Robot,'" *Defense One*, May 1, 2017, http://www.defenseone.com/technology/2017/05/when-robots-storm-beach/137464/.

7 Dave Ross, "Paul Scharre: Autonomous Weapons and the Future of War," *MyNorthwest* (podcast), September 29, 2017, http://mynorthwest.com/category/podcast_player/?a=10022893&sid=1091&n=Ross+Files+with+Dave+Ross; Michael Horowitz, "The Future of Warfare Is Fast Approaching in the Pacific: Are the U.S. Military Services Ready?," War on the Rocks, June 2, 2017.

8 For example, the Littoral Battlespace Sensing-Glider (LBS-G). See Pete Hudson, "Unmanned Warfare Systems Vision and Mine Warfare," Powerpoint presentation, November 17, 2016, http://www.minwara.org/wp-content/uploads/CAPT-Hudson_N99-Overview.pdf; U.S. Navy, *UUV Master Plan,* November 9, 2004, 10–17, http://www.navy.mil/navydata/technology/uuvmp.pdf.

9 North Korea conducted its sixth, and largest, nuclear test on September 3, 2017. CSIS Missile Defense Project, "North Korea Conducts 6th Nuclear test," *Missile Threat*, September 7, 2017, https://missilethreat.csis.org/north-korea-conducts-6th-nuclear-test/.

10 Franz-Stefan Gaudy, "Russia Tests Nuclear-Capable Underwater Drone," *The Diplomat*, December 14, 2016, http://thediplomat.com/2016/12/russia-tests-nuclear-capable-underwater-drone/; Ryan Browne, "US General Warns of Out-of-Control Killer Robots," CNN, July 19, 2017, http://www.cnn.com/2017/07/18/politics/paul-selva-gary-peters-autonomous-weapons-killer-robots/index.html.

11 Predicting the consequences of deploying a long-endurance nuclear-armed UUV in contested waters or off an adversary's coast requires more consideration than can be given in this piece.