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Robotics and Autonomous Systems in Land Operations

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ROBOTICS AND AUTONOMOUS SYSTEMS IN LAND OPERATIONS

AIM

1. The presence of Robotics and Autonomous Systems (RAS) in the land component of the Canadian Armed Forces (CAF) is currently relatively low, even in comparison to other components. The purpose of this service paper is to identify land operations and functions that could benefit from augmentation by Robotics and Autonomous Systems. This paper will not provide or suggest specific currently available, RAS technologies and products that could be considered for procurement. Although, this may become an endeavor for procurement specialists, it remains outside the scope of this paper. This paper rather, is intended as reference to decision makers as to where the CAF could employ RAS technology to enable success in present and future operations. The paper is also not intended to explore or identify the ethical, political, or legal ramifications for the implementation of such technologies. It is acknowledged however, that such topics are being, and must continue to be explored in complete detail, prior to procurement of such technologies.

INTRODUCTION

2. What is meant by autonomy? "Autonomy is the ability of a machine to perform a task without human input. Under this definition, an autonomous system is a machine, whether hardware or software, that once activated performs some task or function on its own."[1] Although Robotics and Autonomous Systems have currently advanced to the point where integration into land operations is viable. RAS is present everywhere in the current operating environment. These systems can be found in all sectors of civilian life and have been used effectively in both the maritime and air components. Our closest allies, Britain and the United States have recognized RAS as a reality and necessity throughout land operational functions.[2] Nations such as China and Russia have moved forward on programs to integrate RAS into their respective ground forces. This includes already developed and, in some cases, implemented, Uninhabited Ground Vehicles (UGVs).[3] At the economic level, the "Compound Annual Growth Rate (CAGR) of the RAS market is estimated to be 20.75% between 2020 and 2025."[4] All this to say, RAS is a technology of the present, and will only increase in prevalence, capability, and relevance in both civilian and military applications.

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[1] Rossiter, Ash. "The Impact of Robotics and Autonomous Systems (RAS) Across the Conflict Spectrum." Small Wars & Insurgencies 31, no. 4 (2020): 691-700., p. 693

[2] Congressional Research Service. U.S. Ground Forces Robotics and Autonomous Systems (RAS) and Artificial Intelligence (AI): Considerations for Congress. CRS Report, 2018.

[3] Ibid., 11-13.

[4] "The Military Robotic and Autonomous Systems Market is Anticipated to Grow at a CAGR of 20.75% Based on Market Value during the Forecast Period 2020-2025: Global Military Robotic and Autonomous Systems (RAS) Market to Reach $26. 13 billion by 2025. Key Questions Answered in this Report: • what are the Key Trends in the Military Robotic and Autonomous Systems Market Across Different Regions?" NASDAQ OMX's News Release Distribution Channel, Nov 05, 2020. P1

3.   For better or worse, robotics and autonomous systems will change how professional militaries operate and how conflicts are fought. Russian President Vladimir Putin speaking of AI stated, "Whoever becomes the leader in this sphere will become the ruler of the world."[5] The question is not whether or/not CAF land forces should adopt RAS but rather where RAS can best fit within the CAF's current system. The discussion portion of this paper will first look at some of the real and perceived risks of increasing RAS presence into land operations. The remainder of this paper will identify where these technologies can be of benefit to land operations within each of the five operational functions; Sense, Shield, Command, Act, and Sustain.

DISCUSSION AND ANALYSIS

4.   A common theme about resisting RAS, stems from the idea that they will replace humans.[6] The common theme through-out academia however is no. The current line of reasoning points toward human RAS integration or teaming.[7] This will allow many autonomous systems to operate under a few human operators. The technology will certainly cause organizational changes and this concept should be further explored but due to the nature of warfare, humans are still required. As an organization in a recruiting crisis, RAS could be the answer to doing more with less.

5.   The second limitation to the incorporation of RAS are the ethical, legal, and political considerations. As stated in the aim, the ethical and policy restraints are not the goal of this paper. Without a government policy on them however, decision makers must be cognizant that restrictions on the acceptable level of autonomy must be emplace. This is especially true for any system that is capable of creating a kinetic effect, to include the highly controversial subgroup of Lethal Autonomous Weapon Systems (LAWS).[8] For these reasons, further discussion within this paper will assume that future RAS integration into CAF land operations will be dependent upon them being an augmentation of human operators vice fully autonomous. It is important to note however that there are many states and non-state actors capable of developing and acquiring RAS that do not hold themselves to the same accountability standards as western nations. The ethical concerns of the West will not stop LAWS from being produced and utilized by other state and non-state actors. It is therefore, extremely important that discussions and policies relating to the integration, application and defense/prevention of RAS be conducted sooner rather than later.

6.   **SENSE**. The sense function has arguably seen the majority of RAS technology up to this point in time. This stems from the introduction of Uninhabited Aerial Vehicles (UAVs). In current, and common usage by land forces in the CAF at the tactical level, these assets could be further augmented by Uninhabited Ground Vehicles (UGVs). UGVs have key advantages over inhabited systems. These being endurance and range because

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[5] David Myer, "AI Power Will Lead to World Domination, Says Vladimir Putin," Fortune, September 4, 2017. https://fortune.com/2017/09/04/ai-artificial-intelligence-putin-rule-world/.
[6] Scharre, Paul. "Robotics on the battlefield part II." Center for New American Security (2014)., p48
[7] Ibid.
[8] Congressional Research Service. U.S. Ground Forces Robotics and Autonomous Systems (RAS)…, p33-38.

they do not have the same inherent sustainment requirements. Further, because there is no operator present, the risk to a soldier's life is non-existent, they can therefore operate far beyond areas conventionally considered too risky.[9] The implications of this at the operational level are massive. It would be game changing for Intelligence Preparation of the Operating Environment (IPOE). Deploying several UGVs forward prior to main body insertion would result in an exponentially greater degree of fidelity. This tactic could be utilized anywhere on the conflict spectrum, but specifically in deep operations, Chemical, Biological, Radiation, Nuclear environments[10] as well as theatre opening. It would further remove a significant amount of tactical ambiguity from forced entry operations where inserting human forces ahead of time, is extremely risky.

7.   The second and perhaps more important area RAS can help in the sense function is in data synthesis. Currently data collection is out pacing the capacity to organize and synthesize it into information and knowledge.[11] The synthesis of the data is still done by intelligence operators and analysts. RAS here could be teaming our highly trained operators with an AI that could drastically shorten the time frame in which it takes to deliver the most accurate intelligence picture possible.

8.   **SHIELD**. The shield function will become the most important area for the CAF in terms of RAS integration. Due to adversarial nations not being disadvantaged by accountability it is inevitable that RAS, forbidden from being used, will be utilized against us or our allies. The CAF therefore must be prepared to face these challenges and they will likely be insurmountable for any human operator alone. The processing speed of AI is far beyond that of the human brain. The Royal Canadian Navy's, Close-in Weapon System (CIWS) is an example of this. It is a semi- autonomous system in common usage which protects the ship from incoming, aircraft, anti-ship missiles, small boats, and surface torpedoes.[12] In many cases the time window for engagement after identification and prior to impact is simply too short for a realistic human response. The system therefore provides a shield capability that no number of human sailors could provide. This same technology can be applied to land forces and would greatly benefit all operations in the application of point area, and route defense of ground and air targets. In peace support and stability type operations RAS would free up soldiers from the necessary but person power intensive tasks of base security by replacing sentries and observation posts with autonomous systems.[13] Systems that are not affected by fatigue, boredom, or atmospheric condition could monitor pattern of life and identify possible threats which are fed directly back to a command center for a decision. Like the CIWS, their ability to kinetically engage targets can be programmed for different levels of

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[9] Scharre, Paul. "Robotics on the battlefield part II." Center for New American Security (2014)., p11
[10] Congressional Research Service. U.S. Ground Forces Robotics and Autonomous Systems (RAS) and Artificial Intelligence (AI): Considerations for Congress. CRS Report, 2018., p11
[11] Isaac R. Porche III, Bradley Wilson, Erin-Elizabeth Johnson, "How do We Deal with a Flood of Data," RAND, June 23, 2014.
[12] Ash Rossiter (2020) The impact of robotics and autonomous systems (RAS) across the conflict spectrum, Small Wars & Insurgencies, 31:4, 691-700, DOI: 10.1080/09592318.2020.1743481., p694.
[13] "Sentries at the Intersection of Technology and Security: NetworkNewsWire Editorial Coverage." PR Newswire, Mar 23, 2021., p3.

autonomy based on threat and policy. In an era of strategic personnel caps on missions, this technology will enable deployed troops to focus on their primary tasks. Autonomous systems could also provide protection from mines, improvised explosive devices and other threats while soldiers are operating in hostile or unknown environments.[14] An autonomous clearance system could move ahead of soldiers to identify threats and pass info back to the commander without having to expose actual human soldiers to the threat. This application could be applied either with or without an attack capability separating human soldiers from the most dangerous situations, increasing mobility and survivability.

9.   **COMMAND**. RAS opportunities for the Command function, relate closely to data management as explained for the sense function. It surrounds data processing. IA combined with operators in a command post can both lower the operational footprint of ops centers increasing mobility and survivability but can also speed up the decision action cycle. RAS can aid commanders at all levels in making quicker and more informed decisions simply due to its exponentially higher processing speed.[15] Its application is universal, from peacetime domestic command up to and including war. Further, RAS is essential for the emerging swarm[16] tactics which will require a level of connectivity and instant understanding between systems that can only be achieved by AI.

10.   **ACT**. As Rossiter states "military robotics are a way of putting the focus of warfare closer to the enemy but at the same farther from oneself."[17] The Act function in many ways strikes at the heart of the ethical debate surrounding RAS. When looking at integrating RAS into the act function, full autonomy is likely not an option for the foreseeable future. Semi-autonomous systems which are armed but utilize force only in commander decided situations are the more realistic. Armed drones are an example of this and as stated above, in development and usage by both allied and adversarial states. Optionally Manned[18] or Uninhabited Ground Combat Vehicles (UGCVs),[19] enable more boots on the ground by not having to train drivers, gunners, and crew commander's separately as all of these functions can be done by the system and a single remote operator. As the technology advances this ratio is likely to change drastically with one operator controlling a swarm of UGCVs. Not only will it reduce friendly casualties but will also lower costs of training.

11.   **SUSTAIN**. The sustain function also stands a lot to gain from robotics and automated systems. As one of the most diverse and complex op functions, encompassing the broadest gambit of tasks throughout the spectrum of conflict, it will be impossible to cover all the areas where RAS could be included. There are some broad areas where

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[14] Congressional Research Service. U.S. Ground Forces Robotics and Autonomous Systems (RAS) and Artificial Intelligence (AI): Considerations for Congress. CRS Report, 2018., p9.

[15] Ibid., p8.

[16] Scharre, Paul. "Robotics on the battlefield part II." Center for New American Security (2014)., p10.

[17] Ash Rossiter (2020) The impact of robotics and autonomous systems (RAS) across the conflict spectrum, Small Wars & Insurgencies, 31:4, 691-700, DOI: 10.1080/09592318.2020.1743481

[18] Security, Television Network, Kris Osborn Author by, and Warrior Maven. "Army Brings AI-Combat Speed to Tank Warfare." CNN Wire Service, Sep 14, 2021.

[19] "QinetiQ and Pratt Miller Deliver First Robotic Combat Vehicle - Light to U.S. Army: Robotic Leaders Provide Revolutionary Solution for the RCV-L Program." PR Newswire, Nov 11, 2020.

sustainment would benefit perhaps more than other areas and this is in automated resupply, and casualty extraction.

12.   Combat resupply is dangerous, time consuming and necessary, automation can take some of the risk, and time out of the equation both by UGV and potentially even delivery drones which are currently in use in the civilian sector.[20] Automating these types of operations takes the risk a way from human operators specifically in close or complex terrain such as mountains and urban scenarios where securing MSRs becomes complicated and person power intensive requiring Act assets to be re-assigned to Shield. The time spent evaluating monitoring quantities of supplies and submitting requests could also be taken on by an AI. The potential lies at every echelon. At the fighting echelon automated systems can not only lighten the personal load of individuals but it can also enable smaller units to increase the amount of supplies they can carry forward.[21] This is especially beneficial for light forces and special operations. The reduced re-supply frequency will facilitate greater dispersion of ground forces by reducing the frequency of resupply and therefore increasing survivability. On top of reducing risk, RAS integration would drastically reduce the tasks of our currently understaffed sustainment battalions.

13.   Automated vehicles with medical AI will also become relevant in casualty evacuation.[22] Sending a UAV for extraction enables the possibility of extraction into more dangerous areas due to no risk to the crew. It will also free up crews to work in the medical facilities.

CONCLUSION

14.   As described above robotic and automated systems will eventually become relevant in every aspect of land-based operations. The integration of RAS in land operations will enable our forces to operate faster, with more precision and less risk to friendly troops. They enable the CAF to remove many of the required but monotonous, and time-consuming tasks that surround land ops such as data processing, and camp security. It can also help shoulder some of the danger in ambiguous and contested environments with threats of IEDs, ambush, CBRN, and deep, forward of own troops operations. Incorporating RAS systems in a "many-to-one"[23] employment style will enable our relatively small force to multiply its outputs for a fraction of the cost of increasing the personnel cap. It will overall make the force more effective domestically and internationally. Perhaps most importantly RAS will enable land forces to protect themselves from automated systems in use by adversaries. Despite the ethical, legal and

[20] "Drone Delivery: ISRAEL." *The Globe and Mail,* Oct 12, 2021.
[21] Congressional Research Service. U.S. Ground Forces Robotics and Autonomous Systems (RAS)…., p22.
[22] Handford C, Reeves F, Parker P. "Prospective use of unmanned aerial vehicles for military medical evacuation in future conflicts." BMJ Military Health 2018; 164:293-296.
[23] Ash Rossiter (2020) The impact of robotics and autonomous systems (RAS) across the conflict spectrum, Small Wars & Insurgencies, 31:4, 691-700., 693.

political concerns with RAS, it is inevitable that it will be employed against western forces.[24] Will CAF land forces be able to respond?

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[24] Congressional Research Service. U.S. Ground Forces Robotics and Autonomous Systems (RAS) ..., summary.

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