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AI APPLICATIONS TO THE BATTLEFIELD

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AI APPLICATIONS TO THE BATTLEFIELD

By Major Jean-François Legault

ARTIFICIAL INTELLIGENCE APPLICATIONS TO THE BATTLEFIELD

1. To analyze the possible impacts of Artificial Intelligence (AI) on operations. Explore the different possible utilization of AI on the battlefield throughout the components and expose the advantages, disadvantages and limitations. A particular focus will be put on unmanned and AI enable platforms' impact on the war fighting functional domains (ex: fighting drones vs. manned aircraft, tanks or ships, ISR, logistics, comms).[1] This analysis will aim to make recommendations to the Canadian Joint Operations Command on AI use throughout the future theatres of operations.

INTRODUCTION

2. Historically the concept of AI dates back to the Greek mythology where there was mentions of artificial entities that could think by themselves in Ovide's story of *Pygmalion and Galatea.* In the 20th century, there have been several mentions in the literature of the advent of robotic entities that could think and act autonomously like in the precursor work of Vannemar Bush: *As We May Think*.[2] In 1950, A.M. Turing, in his article *Computing Machinery and Intelligence*[3], lays the details of a test he designed (the Turing test) to determine if a system is intelligent by human standards. But the actual origin of the term *AI* dates back to 1955. It was coined by John McCarthy[4], a mathematician and computer scientist that invented the LISP computer programming language. This language or its derivatives are still in use today. AI had a golden age in the 1980s where a number of universities and big corporations used LISP to create *Expert Systems.* Those systems helped in the prediction of financial market trends, in establishing medical diagnostics or calculating weather patterns. But those systems mainly relied on huge databases and were heavy in human maintenance. Expert systems were essentially a relatively expedient search engine that could learn from previous predictions results and searches to recommend actions according to their databases. If the database was flawed so was the recommendations. The cost of maintaining those systems, the huge need in data and the limited computing power of the 1980s limited the development of AI at that time.

3. Today AI is everywhere in our day-to-day activities. The advent of the neuronal chips, the proliferation of the internet, the multiplication of interconnected systems, the miniaturization of computing power and the emergence of big data centres are just some factors that contributed to the return of AI to the front stage. Today AI is mainly used for economic and capitalistic purposes. It analyzes our activities online in order to better target audiences with content. Similar to expert systems of the past, algorithms in those

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[1] Canadian Forces College 2021/2022, JCSP Research Topic List, p. 15 D.9
[2] Vannevar Bush, "As We May Think," The Atlantic, July 1, 1945, https://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/.
[3] A. M. Turing, "I.—Computing Machinery And Intelligence," *Mind* LIX, no. 236 (October 1, 1950): 433–60, https://doi.org/10.1093/mind/LIX.236.433.
[4] Britannica, T. Editors of Encyclopaedia. "John McCarthy." Encyclopedia Britannica, January 11, 2022. https://www.britannica.com/biography/John-McCarthy.

AI enable systems use massive databases that collected information on our online habits to predict what users would like to digitally consume in order to tailor advertisements. In essence the AI of today is the same as the AI of yesterday but with better inter-connectivity and greater dispersed computing power. It still relies on algorithms that searches and learns from incredible amounts of data. No AI system of today can successfully complete the Turing test. A system that responds to a human without the human noticing it is not another human would still require either a lot of computing power or a breakthrough in AI programming. This might come to pass as developments are made in quantum computing, but we are far from a portable design that could be applied to some sort of military drone.[5] With all this being said, we see that a fully autonomous military platform, that does not rely on access to a networked database to make a decision is not feasible at the moment. This does not mean that current development in AI is not useful on the battle field, only that we cannot have the "I Robot," "Elysium" or "Chappie" movie-style robot soldiers yet in the field.

4. Military drones are widely used for information, surveillance and reconnaissance (ISR). Some more advanced drones go beyond the simple ISR role and carry weapons like the American Reaper, Predator or the brand new Preadator C Avenger. They all have a degree of autonomy to facilitate control but target acquisition and prosecution is always done by a human operator. A UN report made a mention of an exception to the last statement. The use of Kargu-2 drones in Libya by Turkish forces is the first report of the use of drones to target humans independently. They were launched with an area to patrol and some specifications as to what the targets would look like and the machine did the rest.[6] Signs that fire and forget loitering munitions are possible in today's battles.

5. Currently AI enables autonomous drones, weapons systems or vehicle is very limited. They are used in a defensive role like the United States' Phalanx close-in weapon system (CIWIS) who can identify, target and destroy incoming threats almost independently. It uses its integrated radar and targeting system to estimate incoming hostile planes or missiles trajectories and destroy them faster than any human operator could do.

6. Autonomous systems and platforms are under development for many states' militaries. The effective use of AI in those systems will be a game-changing event. The Canadian Armed Forces does not stray from this path. The Canadian Army envisions the use of autonomous guided surveillance assets (air or ground), autonomous land and air systems to deliver supplies and networked enable mobile repair teams.[7] Some of the

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[5] Jean-Françoîs Venne, "Informatique Quantique: Entre Promesses Et Menaces," *Gestion* 45, no. 4 (Winter 2021): 42–45.

[6] UN Security council, "Final report of the Panel of Experts on Libya established pursuant to Security Council resolution 1973 (2011)", (New York : UN, 8 March 2021), p. 17. https://undocs.org/en/S/2021/229

[7]Canada. Department of National Defence. Close Engagement: Land Power in an Age of Uncertainty: Evolving Adaptive Dispersed Operations. Kingston, ON: Canadian Army Land Warfare Centre, 2019. https://publications.gc.ca/collections/collection_2019/mdn-dnd/D2-406-2019-eng.pdf

Royal Canadian Airforce advocates recommend specializing in high altitude long endurance unmanned aerial vehicles coupled with AI analysis tools.[8] With all those developments in unmanned vehicles and given the democratization of those devices, it is understandable that the Royal Canadian Navy is concerned by the threat of UAV swarms to their stationed vessels and calls for a naval specific solution to drone attacks.[9] All components have a vested interest in AI enabled drones and have included it in their future doctrine.

DISCUSSION

7. If we consider all that was discussed in the introduction, the use of AI controlled unmanned vehicles in war-fighting is still in its infancy. The application of lethal forces to the battle field is still and will still be in large part in the hands of humans. Although we could argue that some weapons make some decisions on their own while attacking or defending like the Kargu-2 or the Phalanx example. Both examples relate mainly with automation and not AI. The Kargu-2 drones attack is similar to a mine. If you step on a mine it explodes, if the targets have the characteristics programed in the drones it attacks.

8. But for the near future, current AI can still bring an enhancing effect on the battlefield on all war fighting functional domains. For example, semi-autonomous logistic vehicles are already being fielded in the United States Army.[10] Although these unmanned vehicles still have to be led by a manned one initially, they can then reuse the same path autonomously afterwards. Effectively creating an autonomous supply chain that can run night and day. Another AI enhanced application would be to assist armoured fighting vehicle (AFV) operators to navigate the battle field and support ground troops. This type of AI enabled AFV could analyze its surroundings and recommend different courses of actions. The crew commander could then select the plan. As the crew commander interacts with his vehicle, the AI would come to learn how to operate better with its user.[11] This would be a similar application of the AI algorithms that tailor our online experience but for battle.

9. The same AI support could be used to assist decision-making at the operational level. The amount of information that is fed up the chain of command is and will ever be growing. The analysis of all the sources of information by humans alone is becoming nearly impossible. If you add to this human experience that changes the way commanders

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[8]Goette, Richard. Preparing the RCAF for the Future: Defining Potential Niches for Expeditionary Operations. Canada: Royal Canadian Air Force Warfare Centre, 2020. https://publications.gc.ca/collections/collection_2021/mdn-dnd/D2-420-2020-eng.pdf

[9]Deschênes, Patrice. "The Rise of the Drones: Technological Development of Miniaturised Weapons and the Challenges for the Royal Canadian Navy." Canadian Military Journal 19, no. 2 (Spring 2019): 51–56. http://www.journal.forces.gc.ca/Vol19/No2/PDF/CMJ192Ep51.pdf

[10]"Army's New Semi-Autonomous Vehicles," YouTube video, Posted by "The U.S. Army," 3 Jan 2020, https://www.youtube.com/watch?v=S42Lzjuy8t0.

[11] "Army Researchers Augment Combat Vehicles with AI," www.army.mil, accessed January 23, 2022, https://www.army.mil/article/236733/army_researchers_augment_combat_vehicles_with_ai.

see the battle field, the decisions made by one commander can be drastically different from another one in the same situation. An AI support could level the plain field by realistically assessing the risks of different courses of action without the human factor as it is recommended in this NATO article on the subject.[12] The commander would still have the choice to go with his instinct but with analytical information. Overtime the decision-making recommendation of the system would be informed by previous recommendations and decisions thus giving better courses of actions. That being said, an AI system of this sort would only be as good as the data that is fed in the database and the algorithm that analyzes it. And as we can see with our online experiences, these algorithms and databases are not without flaws.

10. Another interesting AI enabled application for the battlefield is the creation of an overall instantaneous common operating picture. This system would function similarly to the popular traffic application "Waze."[13] The users would input events in the system and machine learning algorithms would analyze the data, give the current operational and tactical situation to all elements, evaluate trends and risks. This would integrate ISR collection and dissemination at the time in one single system. Some of the obstacles right now to implement this type of system is the requirement for a reliable network access for all users on the battle field linked to a deployable computing and data centre. Moving a data centre with enough computing power in a hostile environment will be a challenge if AI to this magnitude is applied to operations.

11. In all this new technology, we also have to consider that Canadian Armed forces rarely operate by itself. We are usually part of a coalition. As demonstrated by the research in the application of AI to operations, Canada's main ally is developing autonomous platforms that are enabled by AI. To stay relevant in those coalitions we will have to adapt to the new technologies that our allies adopt and coordinate our own evolution in AI use with those same allies. Integration with what our allies use will be essential. Otherwise we will not be able to operate with them and we will not see what they see.

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[12]Van den Bosch, Karel, and Adelbert Bronkhorst. "Human-AI cooperation to benefit military decision making." NATO, 2018. https://www.karelvandenbosch.nl/documents/2018_Bosch_etal_NATO-IST160_Human-AI_Cooperation_in_Military_Decision_Making.pdf

[13]"Waze for War: How the Army Can Integrate Artificial Intelligence," War on the Rocks, September 2, 2016, https://warontherocks.com/2016/09/waze-for-war-how-the-army-can-integrate-artificial-intelligence/.

CONCLUSION

12. The useful use of AI enabled autonomous platforms or systems has been in the works for some time. From its inception, AI has never been true artificial intelligence. It cannot grasp the subtilities in situations like a human can. The AI we see and use in our everyday life is just a collection of data that is used in a certain way by algorithms. We can compare it to nothing more than advanced automation. Until the databases can hold infinite possibilities and the computing power can navigate this data instantaneously, we will not have true artificial intelligence. Hence fighting robots that apply what was programmed will only be as good as their programming.

13. Fortunately, current AI has a lot to offer in a variety of aspects. It can optimize and automate logistical chains. It can control point defence systems or could assist in controlling an AFV alongside soldiers fighting a battle. It could be used as a decision-making tool for operational commanders. It can and will continue to collect and analyze evermore massive amount of ISR sources and eventually distribute an instantaneous common operating picture to all elements. It will identify trends and risks and inform actions in all domains of operations.

14. This augmentation of war fighting functional domains efficiency through the use of AI has some obstacles to cross before becoming effective. It will have to be robust, scalable and deployable. The reliance on strong network connection will also be a challenge and will have to be mitigated with some sort of autonomy or dispersed control in case the communication environment is degraded. Lastly, integration with allied technology will be essential.

RECOMMENDATION

15. This exploration of the applications of AI to the battlefield is not extensive but gives a good perspective to what the trends are, and where our focus should be in respects to AI. A deeper dive in the technical aspect of this technology is required for all components. Regardless of the way ahead, the following characteristics should be paramount in developing our own approach to AI:

a. Robustness;

b. Portable;

c. Redundancy;

d. Flexibility; and

e. Integration.

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