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ARTIFICIAL INTELLIGENCE: WHAT IS IT, CAN IT BE LEVERAGED, AND WHAT ARE THE RAMIFICATIONS?

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AIM

1. The topic of Artificial Intelligence (AI) and its subsequent application is of intense interest to militaries and governments across the world. In a world that is completely networked there is a sense that the individuals or organizations that arrive at AI first will have a marked advantage over others. The purpose of this paper is to provide general information on AI, examine specific capabilities that could be utilized across the War Fighting Functions (WFF) in relation to Unified Land Operations (ULO), and assess some of the legal, ethical, and tactical implications of inserting AI into the human driven decision making loop.

INTRODUCTION

2. To accomplish the above goal a baseline understanding of AI must be articulated, common terms defined, the lens of analysis established, and a refresh on United States (US) military doctrine conducted. The discussion will primarily focus on the application of pertinent AI across the warfighting functions prior to addressing the more conceptual arguments on its usage. The conclusion will readdress critical points articulated throughout, while the recommendation will offer general ideas on the way forward.

3. When discussing AI it is easy to get lost in the myth, pop culture depictions, or ambiguous nature of this rapidly emerging technology. These issues compound the general misconception surrounding AI which muddles our ability to properly analyze it. Up front, AI is not a robot or a container, but rather the software and data inside the robot or container. For this paper the lens we will use are the three levels, or calibers, of AI articulated by writer, illustrator, and TED-Talk speaker Tim Urban. These levels are Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI), and Artificial Superintelligence (ASI).[1] These terms are not specific to him, and are generally accepted throughout the scientific community. ANI is software that is incredibly good at one thing, but cannot do anything else. This AI is already highly utilized throughout the world for navigation systems, autonomous machines, smartphones, algorithms that automatically populate social media feeds and search engines, conduct data analytics, process vast amounts of information, etc.[2] Three relevant concepts pertaining to ANI are Big Data (BD), Data Analytics (DA), and Machine Learning (ML). BD means processing data sets so large they take vast computational resources.[3] DA uses specialized software to find patterns or meaningful information from gathered data.[4] ML is software with the ability to continually improve as it gains experience.[5]AGI is the step past ANI, but has not been successfully built at this time. Instead of being really good at one thing, AGI would have a level of intelligence equal to that of a human across the board. Computer scientist Donald Knuth sums this up perfectly by saying, "AI has by now succeeded in doing essentially everything that

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[1] Urban, "The AI Revolution: Our Immortality or Extinction", *Wait But Why* (blog), 27 January 2015, waitbutwhy.com/2015/01/artificial-intelligence-revolution-1.html
[2] Nils Nilsson, *The Quest For Artificial Intelligence: A History of Ideas and Achievements* (Cambridge: Cambridge University Press, 2009), 185
[3] Dictionary. "Big-Data", Last accessed 9 October 2018, https://www.dictionary.com/browse/big-data
[4] Dictionary. "Analytics-Data", Last accessed 9 October 2018, https://www.dictionary.com/browse/analytics
[5] Dictionary. "Machine Learning", Last accessed 9 October 2018, https://www.dictionary.com/browse/machine-learning

requires 'thinking' but has failed to do most of what people and animals do 'without thinking'".[6] The final level of AI is ASI, which is an intellect vastly superior to that of a human. This AI is known as superintelligence. Nick Bostrom, professor at the University of Oxford and highly respected leader in the field of AI defines superintelligence as, "intellects that greatly outperform the best current human minds across many very general cognitive domains."[7] Since ANI is the only level of AI currently available, it will be used when discussing the warfighting functions, leaving AGI and ASI for the conceptual discussion.

4. ULO is the simultaneous execution of offensive, defensive, and stability or defense support of civil authorities' tasks through decisive action on the land domain.[8] Land components accomplish this through the WFF. These functions are Mission Command (MC), Movement and Maneuver (MM), Intelligence (INT), Fires (FE), Sustainment (SUS), and Protection (PROT).[9] MC is the function that is responsible for the development and integration of the other WFF. MM is primarily focused on the employment of forces to achieve positions of relative advantage. INT ensures an understanding of the operational environment. FE is responsible for the use of fire assets and proper targeting. SUS provides support and services to the effect of friendly freedom of action, extended reach, prolonged endurance, etc. PROT preserves the force with the end state of allowing the commander to apply the maximum amount of combat power when required. When executed together these functions allow ULO to achieve decisive action in the land domain.

DISCUSSION

5. BD is the ANI that has the most immediate application to all six WFF due to its ability to track, store, and process vast amounts of information. While not purposefully speaking to BD, American librarian and knowledge management expert Rutherford D. Roger said, "We are drowning in information and starving for knowledge."[10] Information overload is an issue when discussing MC and INT, which in turn impact the remaining functions. The prevalence of technology which can gather vast amounts of data has seen an increase in the amount of useless information commanders and staffs have to deal with. This has exponentially increased the challenge in data storage, organization, and arguably most importantly the ability to sift through the vastness of data for the right information in a way that enables, not hampers. Additionally, when the INT function is attempting to understand the operational environment it is hard to find and disseminate the most important information quickly. U.S. Army General (Retired) McChrystal has spoken about this issue numerous times throughout his career. He pushed heavily for turning important captured enemy material back out to the force on the ground to enable further MM, which made the ability to sift through physical and digital data critical.[11] BD

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[6] Nilsson, *The Quest For Artificial Intelligence*…, 318
[7] Nick Bostrom, *Superintelligence: Paths, Dangers, and* Strategies (Oxford: Oxford University Press, 2016), 3-2
[8] Headquarters, Department of the Army, Army Doctrine Reference Publication 3-0, Operations (Washington, DC: U.S. Government Printing Office, 2017), 3-1
[9] Headquarters, Department of the Army, Field Manual 3-0, Operations (Washington, DC: U.S. Government Printing Office, 2017), 5-2
[10] Trevor Hastie, Robert Tibshirani, and Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction* (Springer Verlag, 2009), 8
[11] Stanley McChrystal *et al, Team of Teams: New Rules of Engagement for a Complex World* (New York, NY: Portfolio/Penguin, 2015), 5-24

is able to assist with the above challenges because it greatly increases the efficiency of data collection and assessment. Staffs and commanders can use BD tools to find the type of information they need to know at that moment, thus increasing situational awareness and enabling plans and decisions. FE can use BD when to process large amounts of targeting variables prior to fire missions, while SUS can better store logistical data or assist with medical issue predictions.[12] PROT could use this software to quickly compute raw materials needed for complex problems. The challenge for BD is the data algorithms are usually narrow. This requires the human dimension to make assessments on the quality of information BD has, as well as draw correlations on associations and patterns within the set of input measures. For software to assist with this issue, it must have the ability to generate some sort of conclusion from the data analysis.

6. The ANI that is able to assess collected data to the degree that it can generate conclusions is known as DA. When discussing MC, DA can analyze the risk of a given decision or lack of a decision using previously established parameters against all of the available data. This could assist both staffs and commanders with an additional lens to better understand or visualize the environment. When used correctly to crunch data the recommendations DA gives could supplement the human experience dimension of ULO. INT can apply this AI when analyzing threat streams or attempting to project the likelihood of an enemy threat network targeting a specific area or event. PROT could analyze the historic sites of enemy attacks with other previously input variables to better prepare for decisive action. FE already uses a variety of AI when conducting fire missions. The AI used by FE assists gunners and joint terminal aerial controllers in delivering precision effects though a variety of conditions using a variety of platforms. While more useful than BD for the ability to generate conclusions and make predictions, this AI is very strict in the software programming and is only able to be used as designed. The ability to adapt and improve performance over time is not inherently a part of DA.

7. ML is the current pinnacle of ANI. When optimized it uses statistical techniques to learn from data to identify patterns without being explicitly programmed to do so[13]. This AI can then make decisions on those patterns with minimal human intervention. The ability of software to develop and improve its performance on a given task over time as it gains experience opens up a wide landscape of options and better analysis.[14] This is the ANI that allows self-operating machines such as cars and drones, assists with facial recognition, and rotational scheduling of platforms.[15] Sophisticated search engines currently use ML to perform at a rate that continues to improve as the software is used. A platform outfitted with ML software could conduct drone resupplies to assist SUS, clear routes for PROT, execute counter fire missions with FE, etc. Industry giant Amazon uses an advanced ML technique called affinity analysis when customers search the website or place items into their digital cart. This technique displays to the customer similar products, more expensive items, and targeted promotions.[16] SUS and PROT could use a similar feature to ensure visibility on like items, additional objects, etc. to assist with logistical

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[12] Nilsson, *The Quest For Artificial Intelligence*…, 512
[13] James Barrat, *Our Final Invention: Artificial Intelligence and the End of the Human Era* (Thomas Dunne Books, 2013), 4-7
[14] Miles Brunage, *et al, The Malicious Use of Artificial Intelligence: Forecasting, Prevention, and Mitigation* (2018), 9
[15] Nilsson, *The Quest For Artificial Intelligence...*, 513
[16] Barrat, *Our Final Invention*…, 4-7

planning or base defense. There is almost no training event, staff function, command decision, or operational task that would not benefit from software that would take large amounts of data, analyze it to output relevant conclusions, while improving its own performance through use. This type of AI is the next natural step when weighing risk to the force or sifting through mountains of data to enable decisions. Full integration of ML software by WFF has an almost limitless application. Since ML technology is increasing at such a rapid rate the U.S. military is having a hard time keeping pace. The U.S. Pentagon has recently established the Defense Innovation Unit to better work with civilian industry on leveraging emerging AI capabilities. This unit provides "non-dilutive capital to companies to solve national defense problems".[17] They essentially form pilot contracts for hardware, software, or other services with the Department of Defense. Lastly, ML has the potential to greatly impact ULO through the ability to make strategy and prioritize long term goals. Software could potentially run millions of simulations with continuously updated data and efficiently to show the best course forward.

8. Some of the legal issues that will continue to arise along with AI are the ability to govern AI Nationalism, laws that would detail interactions between autonomous machines and humans, and where responsibility for decisions made is. As previously stated the current level of usable AI is ANI, however, with the exponential growth of technology many feel that AGI and ASI are not far off. Ian Hogarth, a graduate of the University of Cambridge engineering department and ML company investor, raises the largest legal concern. He argues that the rapid progress of ML is driving a new geopolitics, and that this technology will transform both the economy and military parts of nations. He calls this concept AI Nationalism. Three forms of instability he identifies under this term are the destruction of millions of jobs through automation, new modes of warfare, and the potential speed up in science and technology use.[18] An additional legal concern is how to deal with human and AI interaction. James Barrat, a published writer on this topic, proposes that the rise of AI could place human beings into different camps.[19] If divided into groups of those who want AI destroyed, those who want continued development, and those who want control, the legal adjustments would be far-reaching. Finally, when pertaining to ULO, usage of AGI or ASI would fundamentally change the relationship between populations, information, staffs, commanders, operational conduct, etc. For now, the responsibility for both the making and results of decisions remains within the human dimension. In a future where the software is deciding what to do next, not the programmers, who or what would be legally responsible remains a mystery.[20]

9. There are ethical concerns with AI as well. Some of these are its inability to explain the decision rationale, the risk of removing humans from lethal force implementation, and the use of AI to manipulate social entities. Henry A. Kissinger, former U.S. national security advisor and secretary of state to Presidents Richard Nixon and Gerald Ford, commented on these issues in an article for *The Atlantic* magazine. He highlights that AI would lack the ability to articulate the rationale for decisions made. While the software could make a decision, in a morally ambiguous

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[17] Defense Innovation Unit, "Accelerating Commercial Innovation for National Defense," last accessed 10 October 2018, https://www.diux.mil/

[18] Hogarth, "AI Nationalism", *Ian Hogarth* (blog), 13 June 2018, https://www.ianhogarth.com/blog/2018/6/13/ai-nationalism

[19] Barrat, *Our Final Invention*…, 7-18

[20] Alpaydin Ethem, *Machine Learning* (Massachusetts Institute of Technology, 2017), 13

situation where there is no clear cut answer it could never tell you why it choose one thing over another. This is because the software is governed by algorithms and the interpretations made from observed data and lacks the underlying reality apart from raw data.[21] Ethics is of particular importance when discussing the tactical application of AI. While the command level of operations would initially bear the brunt of integrating higher levels of AI, it would eventually seep down to the tactical level. The rules of engagement would need to change drastically and often to keep pace with adapting technology if the human pulling the trigger is doing so based on AI distinguishing enemy from friendly. Finally, another ethical concern is the use of ANI for social manipulation. The ability to screen or reinforce information through social media platforms to sway populations is already present, but is proving difficult to pin down ethically. Hector Levesque, an academic researcher in the field of artificial intelligence, sums up the vastness of ethical concerns well when he articulates that the knowledge that goes into decisions is an essential component of human behavior.[22] ULO is still a predominately human affair, and the more we remove the human, the more difficult it will be to control ethical employment of AI capabilities.

CONLUSION

10. This service paper provided general information on AI, details on the possible relationship between types of software and U.S. doctrine, and considered various legal, ethical, and tactical implications. AI is an already present factor that is fundamentally changing how the WFF operate throughout offensive, defensive, and stability or defense support of civil authorities' tasks. From a database that serves as a reservoir of information, to autonomous platforms, and complex software capable of generating probability outputs, the ability to leverage AI capabilities will only increase in importance in the future of ULO. With the complexity of the modern operating environment and the need to not only process but understand available information, the military must continue to synthesize AI techniques to assist staffs and commanders. As retired mathematics, computer science professor, and science fiction author Vernor Vinge said, "We are on the edge of change comparable to the rise of human life on Earth."[23]

RECOMMENDATION

11. Three primary recommendations are the result of this service paper. They are increased understanding, further integration, and routine evaluation. The myths surrounding AI do nothing to increase the military's ability to conduct ULO. There should be an investment to ensure commanders at all levels understand current AI technologies, as well as the next step. This will naturally lend itself to the second recommendation of further integration of those technologies. BD and DA are currently being used by high performing units like Special Operations Forces, but these tools should be given to General Purpose Forces. Lastly, routine evaluation on what AI

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[21] Henry Kissinger, "How the Enlightenment Ends: Philosophically, intellectually-in every way-human society is unprepared for the rise of artificial intelligence," *The Atlantic*, June 2018

[22] Hector Levesque, Common Sense, The Turning Test, and the Quest for Real AI (Massachusetts Institute of Technology, 2017), 32

[23] Vernor Vinge, "The Coming Technological Singularity: How to Survive in the Post-Human Era," San Diego State University (1993), https://edoras.sdsu.edu/~vinge/misc/singularity.html

is being used should be conducted to ensure the appropriate level of oversight and responsibility is maintained. Not using emerging tools would be foolish; however, as AI continues to develop the level of interaction from the human dimension must remain key.

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