CHINESE & IRANIAN ARTIFICIAL INTELLIGENCE IN LOW EARTH ORBIT TO THAAD SPACE WARS

Rory Lewis

Department of Computer Science
University of Colorado Colorado Springs, Colorado, 80919, USA

ABSTRACT

This paper addresses what the role of artificial intelligence will be in low earth orbit (LEO) and space war is and specifically, what China and Iran's latest research in artificial intelligence on unmanned aerial vehicles (UAVs) for LEO space war domains has been, is, and strives to become. The author first presents testimony from scholars and space research scientists from many countries who all categorically state, without a trace of doubt, that all future space warfare will be in satellites and unmanned UAVs and how they in turn will rely heavily on artificial intelligence. This paper includes an analysis on China's strengths in space artificial intelligence and, Iran's systematic approach or arming its UAVs. The second portion of this research drills down into what are the specific mathematical theoretical research areas of artificial research for LEO space wars in various countries, including China. The author concludes with research strategies that will combat China's dominance of space wars.

KEYWORDS

Artificial Intelligence, Machine Learning, Space War, Chinese artificial intelligence.

1. INTRODUCTION

The Next Arms Race is in Artificial Intelligence (AI). Scholars in the field say that military-use AI has become a major potential source of instability and great power strategic competition. [1], [2], [3]. During Paul Scharre's testimony before the United States' House Armed Services Committee on January 9, 2018, he stated that China's race to exploit and integrate Artificial Intelligence (AI) into their military is rising exponentially [4], [5]. In fact, the urge to operationalize AI is why the Pentagon has committed to invest $10 billion into geospatial analytical companies [6]. Vladimir Putin aptly stated that the nation that dominates AI will dominate the world. [7]. China has budgeted $150 billion through 2030 on AI research and the U.S. Department of Defence (DoD) is injecting $7.4 billion into AI [8], [9]. Mariarosaria Taddeo, a Turing Fellow and Deputy Director of the Digital Ethics Lab at the University of Oxford, UK, states that space warfare will include cyber and physical attacks. Cyberspace is a domain of warfare, and Artificial Intelligence is a new defence capability. In 2016, AI in the field of cybersecurity was pinned at $1 billion. Now it is predicted to be worth at least $18 billion by 2023 [10]. Furthermore, President Trump has allocated an additional $12.5 billion for AI projects in LEO and Space. Additionally, Heather Wilson, the Air Force Secretary, is funding upgrade of GPS to GPS III and stated that her motivation for this is because GPS runs the US Air Force and, equally important, the timing that synchronizes the entire Western World's banking system, and we cannot afford to have this exploited by aggressive nation states [11]. This is evidenced by the company that codes the AI for the US Army's UAVs who recently stated; "Now I have Artificial

Intelligence protecting the data centre, and now the enemy has to have its own Artificial Intelligence to attack my AI. It's already too late to stop the Artificial Intelligence arms race, we must manage it instead" [12], [13]. Even the F-35 uses AI to distribute battlefield awareness [8], [14], [15], and the office or Naval Research's (ONR) Smart Ship Program also uses AI [16], [17], [18] which is essentially replace sailors [2] on the their 27 CG 47 Ticonderoga-class cruisers [10], [13]. To sum up the realization the US is in danger of losing its lead on Artificial Intelligence to China is evidenced by, William Roper, when heading the US Pentagon's Strategic Capabilities Office, said that his superiors at the Pentagon finally realized that America's world-leading efforts in artificial intelligence were about to be overtaken by China [8], [13], when in March 2016, Elsa Kania, a specialist on Chinese military innovation showed Roper's superiors that it was when Google's DeepMind used Artificial Intelligence to defeat a world champion in the ancient Chinese game of Go, that the Chinese military made a goal to have Chinese Artificial Intelligence surpass the human mind and the US militaries' Artificial Intelligence by 2030 [8].

2. COLD WAR STRATEGIES & ARTIFICIAL INTELLIGENCE CONFLICTS

The Pentagon has acknowledged that deploying conventional Cold War strategies to deter AI-influenced cyberconflicts in Space is highly problematic and there is now a push to specify the role of Artificial Intelligence in future wars and conflicts [19]. The most disruptive of these possible technologies is the potential for Artificial Intelligence housed within quantum computers [20], [21]. Here, the issues is that it is an unknown as to how fast Artificial Intelligence and quantum computing will be available to state and non-state actors seeking to challenge US interests [21], and it is no secret that the first country to create and deploy Artificial Intelligence with Quantum computing will absolutely acquire a decisive advantage over its competitors [21]. This issue was set in steel when General Paul Selva, vice chairman of the Joint Chiefs of Staff, told Congress in 2017, that Artificial Intelligence will might create a "complex battlespace, particularly machine-to-machine interaction in space and cyberspace, where speed is of the essence" [22].

2.1. Directed Energy, Artificial Intelligence in LEO Space War

Unlike conventional weapons that utilize kinetic energy through bullets and missiles, directed Energy in Space includes all weapons that use different wavelengths of the electromagnetic spectrum, from lasers through to micro- waves, LASERs, plasma weapons and pulse bombes [23], [24], [25]. Having Artificial Intelligence in Space can allow a multitude of satellites and other sensors to have their data synthesized automatically through various algorithms [26], [25]. AI and directed energy weapons is without a doubt the new arms race in LEO space with the US, Russia and China [27], leading the way. This is not new, the AI space arms race began years ago when GPS satellites used AI to detect nuclear explosions [28]. The renowned authority on AI-based satellite systems, Prof. Pelton points out that High-Throughput Satellites (HTS) with their sophisticated AI are the most advanced instruments in space [29], [28]. The Missile Defense Agency has an RFI for applied research white papers for applied research that integrates AI on space weapons with LASERs, plasma weapons and pulse bombes and other directed energy systems [30]. The second wave was pattern recognition which when applied on the battlefield, allows computers to control the use of the electro-magnetic spectrum. To validate the seriousness the US Military has for Directed Energy AI Space Systems, DARPA has committed $3.44 billion for 2019 [31].

2.2. The US Military Braces for Artificial Intelligence War in Space

New technologies that promise significant strategic advantages can upset balances of power or disrupt previously stable global governance arrangements [32] and some experts suggest that

Artificial Intelligence in Space will spell "the biggest geopolitical revolution in human history" [33]. Systems such as Caffe [34], and TensorFlow [35] have made it easier to efficiently integrate AI and machine learning into military unmanned ground or aerial vehicles and medical robotics [36] and computation frameworks like have helped designers and engineers build novel and robust unmanned autonomous systems [37], [38]. The reason is that current satellites are bombarding the DoD with some much information that it is drowning in information and has no option but to find AI that can convert all the information into intelligence [39].

The United States Air Force Seeks Non-DoD Space for Artificial Intelligence. One of the problems that DoD has with AI and ML systems is that these systems need the freedom to predict events and when wrong, rewrite their own code. The problem is that the DoD does not permit unvetted computer software or code on any DoD system. This makes it almost impossible for a machine learning system to write its own code because, it needs to be vetted by a human. However, the United States Air Force is the first to realize this and has created the Air Force Cognitive Engine (ACE) platform that will allow AI systems recode themselves [40].

Artificial Intelligence to Rescue THAAD. Artificial Intelligence in Terminal High Altitude Area Defense Missile Defense (THAAD) was a kinetic-energy weapon designed to protect the United States against enemy missile attack. But after $3.2 billion had been spent, the program was deemed a failure, as all five of the initial tests had missed the targets. The Terminal High Altitude Area Defense (THAAD) was developed to intercept short- and medium-range missiles using a hit-to-kill approach [41]. However after $3.2B it was not able to hit any of its test targets. Here, AI is now being installed onto the system to overcome its failures [42], [28]. Additionally, the MDA's C2BMC, Developed by Lockheed Martin and Northrup Grumman, intends to also use AI to synchronize the multi-layered missile defense system with sensors and operators to rescue THAAD [42].

Artificial Intelligence and LAMs. There is no doubt that military AI has become central to the new arms race in space [43]. Take for example, loitering attack munitions (LAMs) that loiter for targets such as enemy radars, ships, or tanks, all based on pre trained Artificial Intelligence targeting criteria, to destroy its target when their sensors detect an enemy's air-defense radar. Some of the earliest LAMs were created by the Israel Aerospace Industries, in the early 1990's where they were specifically designed to loiter in the air and then attack radar installations or mobile missile launchers [44]. The issue is that for a LAM to quickly attack a target area, the battlefield has become much more complex than that if Israel in 1990, herein AI attached to systems in LEO that can assess the entire battlespace have become absolutely crucial [45], [46]. For example, AI on a LAM can ID and destroy an enemy missile much faster than a cruise missile or human being, and can loiter in space for much longer periods [26].

Artificial Intelligence in C2. Similar to LAMs, in concept, Artificial Intelligence is expected to become more widely used in aids to decision making in Command-and-Control (C2) platforms. Again, because Space War is the battlefield is becoming increasingly complex, commanders are realizing that the human brain can no longer keep track of thousands or variables changing each second, here the military is utilizing game-theoretic models and Machine Learning with a systems perspective to effectively analyse complex systems for C2 [47]. Here the issue is that there is considerable mental fatigue and stress, however AI never gets tired and is always very alert [48]. Herein, the US Undersecretary of Defense for Acquisition and Sustainment, Ellen Lord told reporters on May 10 that her office is working on a formal policy for implementing such legislation [49].

Artificial Intelligence and LEO. Satellites in space are likely to remain highly vulnerable to nuclear attack as they occupy the same physical space as ballistic missiles and are also just as

vulnerable to anti-ballistic missile defense systems [6], [50]. China is not pleased where it stands with artificial intelligence and the US Navy in the South China seas [51]. China is frantically trying to use AI in its anti-ship missiles and radar ocean reconnaissance satellites ("rorsats") that can detect where U.S battle ships and carriers are [52]. Intelligence shows that China is serious about catching up to the US in Artificial Intelligence in this domain [53], [54]. Here, DARAPA is connecting military sensors to commercial satellite buses to combat these Chinese goals [55].

2.3. Artificial Intelligence and UAVs.

It is also known that AI can control swarms of autonomous UAVs and outpace the ability of human beings [56]. Even though Artificial Intelligence is controlling these swarms of drones in air and the oceans, intelligence shows that China will roll out AI to control their swarms of ocean unmanned vehicles, to space. As a result, AI will be the only way to counter the aforementioned Chinese swarms of armed drones [26], [57]. China's People's Liberation Army (PLA) has not only verbally designated space as the new domain of war, but also implemented lasers, high-powered microwave, and particle beam weapons to destroy the satellites of foreign. Countries [58], [59], [60]. To combat this, the US is creating Artificial Intelligence systems embedded in US satellites that can detect a Chinese laser and dodge it. The US military has stated that it will incorporate Artificial Intelligence to have the US' constellation of satellites orbiting Earth a "fighting chance". Michael Dickey, of the US Air Force Space Command has confirmed that the DoD is creating autonomous orbiting entries that can dodge missiles and satellite-based weapons. In fact, he stated that the goal is to have Artificial Intelligence help satellites avoid attack is by moving them out of "predictable orbits", including geosynchronous earth orbits [61], [62].

3. CHINA'S ARTIFICIAL INTELLIGENCE IN SPACE.

China has had Artificial Intelligence in Space form its over ten year old scavenger satellite programme according to a recently declassified documents [63]. Similar to SpaceX, China is also developing super-heavy-lift and reusable rockets due for its first test flights in 2030 [6]. Sandro Gaycken, a senior advisor to NATO, has stated that this is incredibly dangerous and that "The naive hippy developers from Silicon Valley don't understand how critical the situation is s is and that the CIA should force them to protect the US from China [64], [65]. It is no secret that China's military ambitions are all based upon on controlling outer space through artificial intelligence. Experts at the Centre for New American Security at Harvard University confirm that the Chinese leadership recognizes and intends to take advantage of AI to enhance its economic competitiveness and military capabilities [66]. Chinese Beidou satellites are already competing with the US constellation of state-of-the-art satellites. The Beidou navigation system constellation consists of eight Beidou satellites and provide navigation and positioning in the Asia-Pacific Region. The Beidou technology is based on the Position And Navigation Data Analysis (PANDA) built by Wuhan University [67], [68], [69]. Additionally, it is generally accepted that China's Secretive Space Program may threaten NASA's Dominance. This was seen by the recent launch of the Shenzhou 11 spacecraft in western China last month where President Xi Jinping stated he hopes the space missions will lead the world in 21st-century technologies. [70].

China plans to continue jamming U.S. Satellites. Satellites control GPS, ATMs, credit cards, telecommunications, time and television [71]. A disruption of GPS services will affect cars, shut down most airplanes, cargo vessels, supply-chain management systems, and transportation hubs driven by GPS [71]. China's overall strategy is to use terrestrial jamming techniques to deny freedom of movement on the battlefield by creating Anti-Area/Area Denial (A2/AD) environments [72]. These jamming procedures will continue against the US' Advanced Extremely High Frequency (AEHF) systems [73], [74]. ASAT weapons are designed to destroy military satellites. The detection of when these orbits are changed is critical in the AI war

between China and the US [75]. Additionally, to stand off missile attacks, Terminal High Altitude Area Defense (THAAD) missiles, Aegis Sea-based Missile Defense systems, Aegis Ashore systems, and Patriot Advanced Capability-3 (PAC-3) to name a few[30]. Last but not least is cyber capabilities [76] and detecting New Orbits of Adversary Satellites is also critical [77].

4. IRANIAN ARMED UAVS.

Along with AI in LEO when it comes to shear destruction, IRAN has a family of Delta wing drones that pose an imminent threat in the region because traditional means to combat larger missiles, LEO objects are rendered useless. Iranian delta wing armed drones such as the *Shahed-129* can carry 8 missiles and has an 1,200 mile range and is capable of conducting serious harm to Israel, Jordan and Saudi Arabia facilities [78], [79]. The Shahed is a smaller version of the U.S. Predator. The *Saeghed-171* can carry four missiles and is modelled after the RQ-170 and is a "medium-range combat reconnaissance" In 2018, Israel shot one down [78]. The *Sadegh-1* , had its first air flight in 2014m has a speed of 120 miles per hour, canloiter for six hours and carry two weapons [78]. The *Mojaher-6.* Was unveiled in 2016, can loiter for 24 hours can go up to 18,000 feet and can only travel up to 120 miles per hour because its propeller driven [78].

5. OTHER COUNTRIES' ARTIFICIAL INTELLIGENCE IN SPACE.

5.1. Russia's Artificial Intelligence in Space.

Russia has invested in the "Nerekhta", and Artificial Intelligence driven unmanned ground vehicle. However, the Russian government's future investment in Artificial Intelligence is unknown. We only know that it only spends about , but reports estimate that it spends approximately $12.5 million a year [7]. This is very small compared to China and the US. China will invest $150 billion through 2030 and the U.S. DoD alone spends $7.4 billion Artificial Intelligence [8], [9]. This may change as Russia does not want to be left behind by China and the US in the AI race [80]. This is evidenced by recent developments in Russia's Foundation for Advanced Research Projects to decrypt images from space with the use of artificial intelligence (AI) to autonomously decoding space information [81]. Additionally. Russia also has plans to its have its humanoid, fly a crewless Soyuz craft to the Internaional Space Station [82].

5.2. The United Kingdom

Recently the UK announced contract between private and public groups investing $200 million of AI investment into the country. Here, the government invests $30 million, Global Brain, a private Artificial Intelligence company invests $50 million and Chrysalix will invest over $100 million. The House of Lords acknowledged that the UK does not have the resources to outspend countries China and the US [7].

5.3. The European Union

An April 25 the European Commission announced a €20 billion investment in artificial Intelligence in weapons that by 2020 will have spent these funds from public and private entities. The problem is that this is a preliminary document. Whether the Commission actually invests this into AI is yet to be seen [7].

5.4. Germany

Chancellor Angela Merkel has recognized the importance of competing with China in AI. She has said she understands that China wants to become the world leader in Artificial Intelligence. And that Germany cannot accept this. However, the German government does not seem to want

to invest in AI. Ironically, it's Amazon that is investing $1.5 million at the Max Planck Institute AI campus in Tubingen [83] [84].

5.5. France

French President Emmanuel Macron announced that France will invest €1.5 billion into Artificial Intelligence research by 2022. Unlike other countries, France will force its private companies publicly release AI code and data [85].

5.6. India

India has announced it will invest in Artificial Intelligence to analyse satellite photographs and Full Motion Video from UAVs for detection, classification, pattern recognition and decision support. Not much is known on the amount it will invest but it will not be close to that of China and the US [86].

6. CONCLUSIONS

It is clear that the new war in space has already begun and that it is driven by Artificial Intelligence. The United States was initially complacent and has allowed China to become very close in some areas of Space War Artificial Intelligence. The issue is that China has built such a huge infrastructure of Artificial Intelligence military and space research, that even though it has not quite beaten the US in the AI Space War, as Eric Schmidt has predicted, it will most likely surpass the US in 2025 – 2030. That, is unless the US suddenly invests huge amounts of research into AI.

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AUTHOR

Dr. Rory Lewis has a PhD in Computer Science and a Juris Doctor in Law. Dr. Lewis is an Associate Professor in the Computer Science Department and the Bachelor of Innovation series of degrees at the University of Colorado Colorado Springs (UCCS) where he is the Program Director of the Masters of Computer Science. He is the recipient of Outstanding Achievement: Teacher of the Year for the College of Engineering, Computer Science. He is the recipient of Outstanding Achievement: Inventor of the Year University of Colorado, for his innovative work in machine learning. He is the recipient of the Diversity & Inclusiveness Award; "Innovations in Scholarship for Inclusiveness" and the recipient of Outstanding Achievement: Teacher of the Year. College of Engr (Student Vote), 2018 and 2019. Dr. Lewis has delivered keynote addresses at i) The Convergence of Artificial Intelligence and the Internet of Things. The role of DNNs, GPUs and artificial consciousness on the future of the IoT. Nov 28-29, 2017 Palo Alto, CA, where Eric Schmidt, CEO of Google, was in the audience, and at ii) the 2nd Annual Autonomous Capabilities for DoD Summit Sept 19-20, 2018 in Maryland where he addressed Deputy Chief of Staffs and generals on Artificial Intelligence, comparing academia and industry versus the DoD Artificial Intelligence and ML research methodologies. Dr. Lewis conducts his Machine Learning research at both the University of Colorado's Colorado Springs campus and the neuroICU ward at the Anschutz Medical School campus. He has also worked at Warsaw University and the Pentagon where he has Secret Clearance and is a Senior Research Fellow in machine learning systems for Intelligence Surveillance & Reconnaissance (ISR). Dr. Lewis is also a Senior Research Scientist for machine learning and artificial intelligence at the RAND Corporation in the analysis of artificial intelligence research in various countries. In the nineties, Dr. Lewis received a Bachelor of Science in Computer and Electrical Engineering from Syracuse University and then, during and after his tenure at
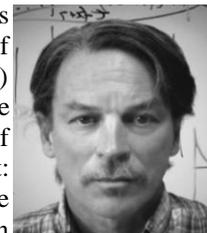
Syracuse College of Law, Dr. Lewis worked at the nation's premier Law firm Fulbright & Jaworski LLC prosecuting high-tech litigation cases involving microprocessor electrical circuitry intellectual property violations such as in Intel vs. AMD where he worked both in San Francisco, CA and Austin, TX. In the early 2000's Dr. Lewis returned to academia to pursue a PhD in Machine Learning. Here he studied under Professor Zbigniew W. Ras who was the PhD student for the "father" of Rough Set theory Zdzislaw Pawlak. Dr. Lewis was awarded tenure in 2017 and was promoted to Associate Professor.