

## MILITARY APPLICATIONS OF AI AND THE FINAL FRONTIER

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October 17, 2024

*(Views expressed in the brief are those of the author, and do  
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**Artificial Intelligence (AI) is set to revolutionize everything from daily life to the conduct of warfare. As major powers strive for dominance, the competition continues in outer space. AI is all set to pervade the final frontier in ways that were unimaginable only a decade ago. AI is not only being used for space exploration, and commercial space arena, but its military uses are testing the boundaries of imagination. AI is being incorporated into data processing for decision-making, Intelligence, Surveillance, and Reconnaissance (ISR), and cyber security. Today, the world relies heavily on space-based satellites for everything from GPS navigation, commercial activity, debris tracking, and ISR to warfare. This essentially means any technologies that can enhance or disrupt the operational environment in space are of vital importance. AI has an increasing role in space. It is, thus, important to assess what military uses AI has in outer space, its benefits and risks, and what it means for global security.**

Military use of AI in space is reshaping and revolutionizing military strategy and operation. AI-enabled military technologies and their use in outer space are being dubbed as “Hyperwar”<sup>1</sup> by

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<sup>1</sup> Amir Husain, “The Military Applications of Artificial Intelligence in Space,” *Forbes*, August 19, 2024, <https://www.forbes.com/sites/amirhusain/2024/08/19/the-military-applications-of-artificial-intelligence-in-space/>.

some. AI is being incorporated into everything from enhancing situational awareness, to satellite maintenance, and enhancing decision-making.

## ISR

Satellites provide tremendous advantages in ISR capabilities. This allows militaries to have real-time information on military movements, targeting information, and missile and nuclear facilities. It affords an advantage in terms of detecting, responding, and being ever-ready against any incoming attack. Essentially, “the integration of AI to fuse sensors in novel ways, extract intelligence autonomously and build predictive models of what they observe, space assets become an even greater force multiplier.”<sup>2</sup> AI integration can make ISR capabilities more effective and efficient. The U.S. has acquired Sentient Vision Systems from Australia which has ViDAR AI system.<sup>3</sup> It can detect targets that are not visible to human operators or radars, which can bolster human capabilities in space. This AI-enabled computer vision can scan visuals for missile launchers or other threats.<sup>4</sup>

The use of AI in autonomous spacecraft and possibly AI-guided weapons is no longer relegated to fiction. Autonomous space platforms can perform many tasks, including reconnaissance, surveillance, and communication. They are also being used for deep space exploration. Autonomy is an essential technology in spacecraft that allows it to make decisions on their own, instead of communicating with the control station on earth for decisions big or small. The U.S. Space Force is also working on AI-based technology that would allow satellites to adjust their orbits to avoid potential collisions. This can be useful as potentially offensive or defensive capability – allowing hitting objects in space or avoiding them.

## Missile Defences

AI also has a significant role in missile defences. The U.S. Space Development Agency (SDA) has tasked EpiSci to develop an AI-enabled software tool capable of detecting launched hypersonic missiles, which have at least Mach 5 speed, using satellite data. The SDA, which is part of the U.S. Space Force, is building a network of as many as 100 satellites in low Earth orbit to provide detection, tracking, and targeting of missile threats.<sup>5</sup> The US\$1.6 million contract with EpiSci is

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<sup>2</sup> Ibid.

<sup>3</sup> Brandon How, “U.S. firm acquires Australia’s Sentient Vision Systems,” April 8, 2024, <https://www.innovationaus.com/us-firm-acquires-australias-sentient-vision-systems/>.

<sup>4</sup> “Artificial Intelligence for Space Missions,” <https://www.boozallen.com/markets/space/artificial-intelligence-for-space-missions.html>

<sup>5</sup> “AI Company Developing Software to Detect Hypersonic Missiles from Space,” *Space News*, February 18, 2024, <https://spacenews.com/ai-company-developing-software-to-detect-hypersonic-missiles-from-space/>.

developing AI-enabled software to sort the data collected by satellites and identify targets in clutter for objects in the atmosphere.

Essentially, AI algorithms are used to analyze a tremendous amount of real-time information and make decisions based on the data. AI-enabled systems can detect hostile objects in space, detect incoming missiles, and make defensive maneuvers accordingly. AI also has a role in ensuring the resilience of space defence components by carrying out predictive maintenance and repairs, ensuring the readiness of the systems.

The U.S. Defense Advanced Research Projects Agency (DARPA) has employed Slingshot Aerospace to create an AI system Agatha that identifies anomalous satellites among large constellations of satellites.<sup>6</sup> It reflects the U.S. concerns with hostile satellites. Agatha claims to be able to identify outlier satellites or ones with nefarious capabilities among constellations.

China has been working on space collision avoidance, space debris tracking, and mitigation projects that aim to integrate AI model algorithms. Essentially, the same technology that tracks space debris can also be used to track other objects in orbit.<sup>7</sup>

### **Decision Making**

Decision-making is where AI may be most relevant. Many countries around the world are utilizing AI. For example, the U.S. Space Force is not using AI to accelerate decision-making and optimize strategic planning.<sup>8</sup> AI can analyze data from satellites to detect potential threats, predict threats, and devise appropriate responses. China may also be working on developing machine learning algorithms to sift through tremendous volumes of satellite data. This essentially promotes faster and more efficient decision-making, in turn, augmenting operational efficiency in the military domain.

### **Cyber security**

AI is increasingly incorporated in the cyber-space offense and defence arena. AI can be a powerful tool in cyber warfare affecting space-based assets. It affords new vulnerabilities and strengths in space and earth-based assets that are increasingly interconnected. AI-capable cyber defences provide protection against cyber-attacks on space infrastructure. Similarly, AI-enabled malware and

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<sup>6</sup> Courtney Albon, "DARPA Project uses AI to Flag Space Weapons, Spy Satellites," June 5, 2024, <https://www.c4isrnet.com/battlefield-tech/space/2024/06/05/darpa-project-uses-ai-to-flag-space-weapons-spy-satellites/>.

<sup>7</sup> Fan Wei, "China to Study use of AI Technology in Avoiding Space Debris," *Global Times*, February 8, 2023, <https://www.globaltimes.cn/page/202302/1285093.shtml>.

<sup>8</sup> Husain, "The Military Applications of Artificial Intelligence in Space."

hacking capabilities can threaten satellites and communication networks.<sup>9</sup> The use of AI in cyber warfare compounds the threats against space assets. At the same time, AI can be a powerful tool for protecting satellites and other assets against cyber threats.

### Challenges and Risks

The increasing use of AI in the outer space domain has some advantages but poses several risks as well. With increasing autonomous space platforms and AI systems in space, there is an increasing risk of errors or malfunctions leading to flawed decision-making that can cause conflict escalation. There are very few regulations governing space weapons, let alone the use of military AI in space. The use of AI in the military space domain will further increase mistrust among major space powers, hastening the brewing arms race in space. There are also questions of accountability and attribution regarding AI-enabled systems. In case of erroneous analysis and decision-making or targeting who will be responsible for the AI systems' actions? This could lead to unintended consequences and escalation. This also brings into focus the ethical issues regarding the use of AI.

Space is increasingly being militarized and weaponized. However, the use of AI is hastening and deepening the process of weaponization of space. It gives an added edge to countries that have military space assets against those who do not. In the South Asian context, India has over a dozen dedicated military satellites. The incorporation of AI-driven technology will give India an edge in ISR, targeting information, troop movements, and more efficient decision-making cycles against a country like Pakistan which remains opposed to militarization of space.

### Conclusion

The space arena is vital for the survival of states today. With an estimated 10000 satellites in outer space, any technology that can enhance the performance or operational effectiveness of space assets or retard it will be a game changer. With the inroads that are being made in the use of AI in space, it has the potential to be that technology. Major powers are pursuing it. However, space is an arena that is not confined to only state actors, many non-state actors also have huge assets in space and access to AI technologies. This makes space a complex environment. The use of AI technologies is likely to deepen the militarization and weaponization of space. It is likely to strengthen both offensive and defensive capabilities. As AI is increasingly being integrated into the space arena, it is vital to regulate it and ensure its ethical use.

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<sup>9</sup> Dr. Zukun Lyu "The Impact of AI on Warfare in Space," *Stratheia*, March 31, 2024, <https://stratheia.com/the-impact-of-ai-on-warfare-in-space/#:~:text=Autonomous%20spacecraft%20and%20satellites%20equipped,communication%2C%20with%20minimal%20human%20intervention.>