Discussion Paper | A Chinese Perspective

Artificial Intelligence and Its Military Implications

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What Is Artificial Intelligence?

Artificial intelligence (AI) refers to the research and development of the theories, methods, technologies, and application systems for simulating, extending, and expanding human intelligence. One of the main objectives of AI research is to enable machines to do complex tasks that usually require human intelligence to complete. As a branch of computer science, it seeks to understand the essence of intelligence and produce new intelligent machines that respond in a way similar to human intelligence. Such machines may attempt to mimic, augment, or displace human intelligence.

AI can be categorized by certain capabilities. Weak or narrow AI refers to artificial intelligence that can simulate specific intelligent behaviors of human beings, such as recognition, learning, reasoning, and judgment. Strong or artificial general intelligence (AGI) refers to AI that has an autonomous consciousness and innovative ability similar to that of the human brain. To put it differently, weak AI aims to solve specific tasks, such as speech recognition, image recognition, and translation of some specific materials. Strong AI can think, make plans, and solve problems, as well as engage in abstract thinking, understand complex ideas, learn quickly, and learn from experiences, which is near to human intelligence. Artificial superintelligence refers to future AI that will far surpass the human brain in its computing and thinking ability, and is what Oxford University philosopher Nick Bostrom described as "much smarter than the best human brains in practically every field, including scientific creativity, general wisdom and social skills."[1]

There are also people who think AI is hard to define because intelligence is hard to define in the first place. Consensus exists that AI is not natural; it's man-made, yet it can reason and make decisions that take various factors into account. In addition, the term "robot" is not a synonym for AI, even if it is sometimes used that way.[2] Fu Ying, former vice minister of foreign affairs of China, writes, "Our discussion of AI and its impact on international relations and even the global landscape can only be limited to the AI technologies and relevant applications that we know of, which use the three major elements of computing power, algorithms, and data, and are based on big data and deep learning technology."[3] She goes on to suggest that discussion should not focus on possible future AI technologies or capabilities.[4]

AI represents an increasingly multidisciplinary endeavor, and its scope of research goes far beyond computer science to include robotics, language recognition, image recognition, natural-language processing, expert systems, neural networks, machine learning, deep

learning, and computer vision. What stands at the core of AI are the often-cited algorithms, computing power, and data, for which the big powers compete.

AI theory and technology are witnessing rapid advances, with increasingly wide application in various domains, such as agriculture, manufacturing, health care, transportation, and even the military. With these advances come social, ethical, and legal implications. AI developers might not always take into account these implications, as that can require proficiency not only in the fields of computer science, psychology, linguistics, and neuroscience but also ethics, law, and philosophy.

Military Application of Artificial Intelligence

Artificial intelligence might affect different aspects of war in unprecedented breadth and depth. For instance, the emergence of predictive maintenance software, intelligent decision-making assistants, autonomous underwater vehicles, or drone clusters could drive a new round of military reform and change the face of war quietly.[5] Fu believes that a state's technological preponderance in AI will quickly become an overwhelming advantage on the battlefield, though it is necessary to understand the military application of artificial intelligence in a holistic way.[6]

On the whole, military applications of artificial intelligence cover two major dimensions. First, AI could be used to improve the performance of traditional and existing weapon systems. Second, AI could assist with or facilitate decision making or make autonomous decisions.

Artificial intelligence might be the most important dual-use technology in the coming decades. Some experts think that AI, as a cutting-edge dual-use technology, has deep and wide application in weapon systems and equipment. Compared with traditional technology, AI-enabled weapon systems would enjoy various advantages, such as having an all-round and all-weather combat capability and a robust survivability on the battlefield, as well as lower cost.[7]

One of the biggest advantages of AI-enabled weapon systems and equipment is response speed, which might far surpass that of the human brain. In a simulated air battle in 2016, an F-15 fighter aircraft operated by the intelligent software Alpha, which was developed by the University of Cincinnati, defeated a human-piloted F-22 fighter aircraft because the intelligent software could react 250 times faster than the human brain.[8]

With the development of AI technologies, intelligent weapon systems that can autonomously identify, lock in on, and strike their targets are on the rise and can perform simple decision-making orders in place of humans.[9] However, these systems possess a low level of intelligence, and the mode of autonomous engagement is usually the last option. But when intelligent technologies progress—such as sensor technology and new algorithm and big-data technology—the autonomy of weapon systems will experience great improvement, and the autonomous confrontation between weapon systems will become commonplace. In certain areas of warfare, such as cyberspace and the electromagnetic spectrum, humans can only rely on intelligent weapon systems for autonomous confrontation. When hypersonic weapons and cluster operations arise, war will enter the era of flash wars[10] during which the autonomous fighting between intelligent systems might be the only way out.

Moreover, AI technologies could be used for intelligent situational awareness and information processing on the battlefield and in unmanned military platforms such as certain aerial vehicles and remote-controlled vehicles. Intelligent command-and-control systems developed by militaries could aid decision making and improve the capacity for intelligent assessment. For instance, the US Cyber Command is attempting to strengthen its cyber offensive and defensive capabilities, with a focus on developing intelligent information systems for analyzing cyberintrusion based on cloud computing, big-data analysis, and other technologies. This approach aims to automatically analyze the source of cyberintrusion, the level of damage to networks, and the data-recovery ability.

The military application of AI would also exert a great impact on military organization and combat philosophy, with the potential for fundamentally changing the future of warfare.[11] For example, the combined application of precision-strike ammunition, unmanned equipment, and network information systems has brought about new intelligent combat theories, such as combat cloud and swarm tactics.[12] With its increasingly extensive application in the military field, AI is becoming an important enabler of military reform, giving birth to new patterns of war and changing the inherent mechanism of winning a war. In July 2016, the US Marine Corps tested the modular advanced armed robot system, which uses sensors and cameras to control gun-toting robots based on AI. Israeli tech firm General Robotics Ltd. has developed DOGO, which *Defense News* described as the "world's first inherently armed tactical combat robot."[13] DOGO is similar to a land-based combat drone. This robot could "revolutionize the way commando units and SWAT teams conduct counterterrorism operations around the world, which is precisely what it was created to do."[14]

AI can enhance the effectiveness of war prediction in at least two ways. One is by calculating and predicting war outcomes more accurately. With the support of advanced algorithms and supercomputing capabilities, the calculative and predictive results of AI systems might be more accurate than in the past. The other is by testing and optimizing war plans more effectively with the help of war-game

systems integrated with AI.[15] For instance, an AI-integrated war-game system can conduct human-machine confrontation, which contributes to finding possible problems and weak points. In addition, such war-game systems can also be used to develop machine-machine confrontation and improve their efficiency.

AI-enabled decision aids can also free up human capacity, allowing humans to focus on major decisions and key tasks in future wars. It is noteworthy, however, that while AI enjoys wide application in the military field, human soldiers remain the ultimate decision makers for when to move into and out of the chain of operations and to take necessary intervening measures. The biggest challenge for the development of human-machine collaborative technology is ensuring humans take over at any time.[16]

Fu also points out "there is still a great deal of uncertainty regarding the impact of AI on military affairs, both in terms of the extent and forms of impact." Experts on strategic studies still tend to analyze their impact on operations from a single perspective. Fu argues that without a holistic understanding of the military applications of AI, the proposed responses could become "a new Maginot line," expensive and useless.[17]

Emerging Issues in the Military Application of AI

Just like other emerging technologies, AI is a double-edged sword. In particular, along with the increasingly wide military application of AI, some issues have emerged and aroused concern across the world. Bostrom, in a report on global disaster risks, argued that AI is more serious than nuclear weapons and environmental disasters.[18]

AI Arms Racing and Arms Control

There is concern about an AI arms race. The late British physicist Stephen Hawking said, "Governments seem to be engaged in an AI arms race, designing planes and weapons with intelligent technologies."[19] The competition for global leadership in AI has been under way for some time. In 2017 and 2018, Canada, Japan, Singapore, China, the United Arab Emirates, Finland, Denmark, France, the United Kingdom, the European Commission, South Korea, India, and others all released strategies to promote AI application and development. These strategies focus on different areas, as AI policy researcher Tim Dutton has written: "scientific research, talent development, skills and education, public and private sector adoption, ethics and inclusion, standards and regulations, and data and digital infrastructure."[20] So, it seems that nations will "spar" over AI through competition in research, investment, and talent.[21]

Kenneth Payne of King's College London wrote in *Survival* that "the idea of arms control for AI remains in its infancy" because "the advantages of possessing weaponized AI are likely to be profound and because there will be persistent problems in defining technologies and monitoring compliance."[22] Military application of AI is often compared to the use of electricity.[23] As with using electricity, no country could be banned from using AI. Just as with the arms race between the United States and the Soviet Union during the Cold War, "an algorithm race between AI powers is likely to emerge in the future."[24] But unlike the arms-control agreements reached between the United States and the Soviet Union at that time, such a consensus on an algorithm-control agreement is unlikely to materialize, given the current state of major power relations.

Ethics

In recent years, along with the development of AI research and industry, some pertinent ethical and social problems have become increasingly prominent. They include security risks, privacy, algorithmic discrimination, industrial impact, unemployment, widening income distribution differences, responsibility sharing, regulatory problems, and impact on human moral and ethical values.

Zeng Yi, a research fellow from the China Academy of Sciences, commented that as a result of design flaws, many AI models at this stage are more concerned with how to get the maximum computing reward but ignore the potential risks to the environment and society. "The vast majority of AI today does not have a concept of self and cannot distinguish between self and others. Human experience, the speculation of external things, is based on one's own experience," he said.[25]

AI systems cannot really understand human values. This is one of the biggest challenges in AI. So it is important for AI ethics studies to consider how to make a machine to self-learn human values and avoid risk. Also, the ethical code of AI should be a topic in the dialogue among various countries and organizations.

In the military field, there are similar ethical problems, in particular those concerning human dignity in the face of autonomous weapons systems. Therefore, research on AI ethics and security is needed and should integrate the efforts of technology and society to ensure that AI development remains beneficial to human beings and nature. Of course, "technological developments will raise new requirements for ethical codes," Zeng said. "However, given the differences in culture and places, it is not only difficult to implement the proposal of unified guidelines, but also unnecessary. Therefore, it is very important to coordinate the ethical standards among different countries and organizations."[26]

Legal Governance

So far there have been more than 40 proposals for AI ethics guidelines issued by national and regional governments, nongovernmental organizations, research institutions, and industries. For instance, in April 2015, the International Committee of the Red Cross published advisory guidance on the use of autonomous weapons.[27] But the various guidelines employ different perspectives on specific issues, and "none of them covered more than 65 percent of the other proposals," according to Zeng.[28]

Also, customary and formal international law remains in flux. In April 2019, the European Commission released a code of ethics for AI and announced the launch of a trial phase of the code, inviting companies and research institutions to test it. On May 25, 2019, the Beijing Academy of AI released the Beijing AI Principles.

In terms of research and development, AI should be subject to the overall interests of humankind, and the design should be ethical; in order to avoid misuse and abuse, AI should ensure that stakeholders have full knowledge and consent of the impact on their rights and interests; in terms of governance, we should be tolerant and cautious about replacing human work with AI.[29] The Tsinghua Center for International Strategy and Security in Beijing proposed six principles for AI related to well-being, security, sharing, peace, rule of law, and cooperation. It also pointed out that these principles are still vague and abstract and that it takes time to refine and discuss them with experts from other countries to find the greatest common divisor.[30] From these proposals, the necessity and urgency for AI governance, especially its military applications, can be detected.

When autonomous weapon systems (AWS) and AI are employed in warfare, the consequences cannot be overestimated. A legal framework to govern the military use of AI is urgently needed. Several issues deserve more discussion:[31]

–   AWS must be defined, including clarifying the differences in the autonomy of mines, unmanned aerial vehicles, and missiles.

–   There is a need to explore pragmatic principles governing autonomous weapons and AI. For instance:

    ·   Should a commander be asked to activate a machine because it can respond faster than a human being?

    ·   What preventive measures should be taken?

    ·   What is due legal deliberation?

    ·   How can offenders be held accountable for intentional violations of international law? Is malfeasance a crime?

    ·   How does one tell if an attack is imminent?

    ·   How can human judgment and human control over the machine be guaranteed?

–   There is a need to discuss the legal threshold for the use of force, including self-defense and countermeasures.

–   There is a need to protect civilians from autonomous weapons. For instance, after years of deploying drones in Afghanistan, the United States might have learned lessons and gained experiences in preventing civilian casualties.

As the issue of AI ethics now draws wide attention, there are opportunities to explore how to apply international laws to AI technology. In the military sense, AI poses a number of problems for international law, which need further clarification and exploration. For instance:

–   Will the principles of international humanitarian law and the law of war be applicable to AI weapons? For example, the principle of distinction between military and civilian targets, the principle of proportionality that prohibits excessive attacks, the principle of military necessity, and restrictions on means of combat.

–   Is there a need for specific rules for AI weapons?

–   How should belligerents distinguish combatants from noncombatants in intelligent warfare?

–   Should war robots be humanely treated?

–   Should AI weapons be accountable for the damage they cause? If not, then should the manufacturer or the user of the weapon be held accountable?

–   When AI weapons violate the principle of state sovereignty, will their actions trigger state responsibility?

Of course, as with nuclear weapons and many other military technologies, "norms will likely follow technology, with law materializing still later."[32]

International Cooperation

Artificial intelligence can significantly improve global productivity and promote world economic development. It can also widen the gap between developed economies and developing countries, alter global supply chains, and change the structure of employment and production. Its military application also draws much attention from both theorists and practitioners.

In his congratulatory message to the 2018 World Conference on Artificial Intelligence on September 17, 2018, Chinese President Xi Jinping said:

"A new generation of artificial intelligence is booming around the world, injecting new momentum into economic and social development and profoundly changing people's way of life. To grasp this development opportunity and deal with the new issues raised by artificial intelligence in law, security, employment, moral ethics, and government, governance requires countries to deepen cooperation and discuss it together.

"China is ready to work with other countries in the field of artificial intelligence to promote development, protect security, and share the benefits. China is committed to high-quality development. The development and application of artificial intelligence will effectively improve the level of intelligence of economic and social development, effectively enhance public services and urban management capabilities. China is willing to exchange and cooperate with other countries in technology exchange, data sharing and application market to share opportunities for the development of digital economy."[33]

International law applies to cyberspace as well as to AI. In cyberspace, experts from different fields communicate with each other, as should be the case with AI, which will help the understanding of how the law applies to AI. Countries can use confidence-building measures and exercise self-restraint. Specific guidelines are often derived from practice, but possible scenarios and security concerns can also be discussed, with a view to furthering international cooperation, making AI a force for good, and bringing AI potential into full play while avoiding possible negative effects.

Conclusion

In 2018, UN Secretary-General Antonio Guterres issued an important document, *Securing Our Common Future: An Agenda for Disarmament*, which outlined a comprehensive disarmament agenda and relevant action plans.[34] He also emphasized the importance of dealing with the emerging means and methods of warfare, including keeping weapons and AI in human control. In the future, under the leadership of the United Nations and active participation and cooperation of states, humanitarian actors, civil society, and the private sectors, the international community needs to explore effective governance and risk mitigation of the AI application to enhance sustainable peace and security for all.

Endnotes

1   Nick Bostrom, "How Long Before Superintelligence?," *International Journal of Future Studies* 2 (1998), https://www.nickbostrom. com/superintelligence.html.

2   Ben Dickson, "What Is Narrow, General and Super Artificial Intelligence," TechTalks, May 12, 2017, https://bdtechtalks. com/2017/05/12/what-is-narrow-general-and-super-artificial-intelligence/.

3   Fu Ying, "A Preliminary Analysis of the Impact of AI on International Relations," *Quarterly Journal of International Politics* (April 10, 2019), https://pit.ifeng.com/c/7lkmTsTwMD2, trans. Brian Tse and Jeffrey Ding, https://docs.google.com/ document/d/1zYU-29n9oIKcMZXM1j3_DMecY77LAs-bdeK5m6CbQ5A/edit?pli=1#.

4   Fu Ying, *Impact of AI upon International Relations*, International Strategy and Security Studies Report, No. 1, 2019, Center for International Strategy and Security, Tsinghua University, 3.

5   Chen Hanghui, "Artificial Intelligence: How Would AI Subvert Future War," *China National Defense News*, January 2, 2018, http:// www.mod.gov.cn/jmsd/2018-01/02/content_4801253.htm.

6   Fu, *Impact of AI*, 8.

7 Yang Xiaonan and Ma Mingfei, "Artificial Intelligence Becomes the Booster of National Defense," *PLA Daily*, July 11, 2018, http://www.mod.gov.cn/jmsd/2018-07/11/content_4819011.htm.

8 Chen, "Artificial Intelligence."

9 For example, the US Aegis system, the Israeli Iron Dome system, the Russian Afghanit active protection system, and the French Shark system.

10 Cluster operation is the centralized deployment of numerous intelligent weapons to attack targets from multiple directions, which can achieve the effect of "quantity is quality" and is perceived as AI-era attrition war. The potential use of drones might serve as an example of this mode of future operations on the battlefield. See Chen, "Artificial Intelligence"; U. Franke, "Flash Wars: Where Could an Autonomous Weapons Revolution Lead Us?," European Council on Foreign Relations, November 22, 2018, https://www.ecfr.eu/article/Flash_Wars_Where_could_an_autonomous_weapons_revolution_lead_us.

11 Yang and Ma, "Artificial Intelligence."

12 "The combat cloud conveys a system in which data is pooled and is available from this via a number of different means. The essence of the 'cloud' notion in combat cloud is that a user is not dependent upon information being pushed to them via a specific means; they are connected to the cloud via whatever means they have at their disposal, and can pull data they are authorized to see as and when necessary." Chris McInnes, "The Combat Cloud," Defense.info, June 30, 2018, https://defense.info/williams-foundation/2018/06/the-combat-cloud/.

13 B. Opall-Rome, "Introducing: Israeli 12-Kilo Killer Robot," *Defense News*, May 8, 2016, https://www.defensenews.com/global/mideast-africa/2016/05/08/introducing-israeli-12-kilo-killer-robot.

14 Adam Linehan, "Meet DOGO: The Cute Little Robot out for Terrorist Blood," Task & Purpose, May 11, 2016, https://taskandpurpose.com/meet-dogo-cute-little-robot-terrorist-blood.

15 Chen, "Artificial Intelligence."

16 Ibid.

17 Fu, "Preliminary Analysis."

18 See N. Bostrom, *SuperIntelligence: Paths, Dangers, and Strategies* (Oxford: Oxford University Press, 2014).

19 Stephen Hawking, interview by Larry King, *Larry King Now*, ORA TV, June 25, 2016, http://www.ora.tv/larrykingnow/2016/6/25/larry-kings-exclusive-conversation-with-stephen-hawking.

20 Tim Dutton, "An Overview of National AI Strategies," Medium, June 28, 2018, https://medium.com/politics-ai/an-overview-of-national-ai-strategies-2a70ec6edfd.

21 Price Waterhouse Cooper, "Nations Will Spar over AI," https://www.pwc.com/us/en/services/consulting/library/artificial-intelligence-predictions/ai-arms-race.html.

22 Kenneth Payne, "Artificial Intelligence: A Revolution in Strategic Affairs?," *Survival* 60, no. 5 (October–November 2018): 19.

23 See Michael Horowitz, Elsa Kania, Gregory C. Allen, and Paul Scharre, *Strategic Competition in an Era of Artificial Intelligence*, Center for a New American Security, July 25, 2018, https://www.cnas.org/publications/reports/strategic-competition-in-an-era-of-artificial-intelligence.

24 Fu, *Impact of AI*, 15.

25 Ren Fang Yan, "Zeng Yi: Multi-Party Artificial Intelligence Ethics Must be Coordinated," ScienceNet, April 21, 2019. http://news.sciencenet.cn/htmlnews/2019/4/425476.shtm.

26 Ibid.

27 International Committee of the Red Cross, "Autonomous Weapon Systems: Is It Morally Acceptable for a Machine to Make Life and Death Decisions?," statement of the International Committee of the Red Cross, April 13, 2015, https://www.icrc.org/en/document/lethal-autonomousweapons-systems-LAWS.

28 Ren, "Zeng Yi."

29 Beijing Academcy of Artificial Intelligence, "Beijing AI Principles," May 28, 2019, https://www.baai.ac.cn/news/beijing-ai-principles-en.html.

30 Fu, *Impact of AI*, 20.

31 See United Nations Institute for Disarmament Research (UNIDIR), *The Weaponization of Increasingly Autonomous Technologies: Concerns, Characteristics and Definitional Approaches*, UNIDIR Resource, No. 6., 2017, https://www.unidir.org/files/publications/pdfs/the-weaponization-of-increasingly-autonomous-technologies-concerns-characteristics-and-definitional-approaches-en-689.pdf.

32 Payne, "Artificial Intelligence," 19.

33 Xi Jinping, "Congratulatory Letter from Xi Jinping to the 2018 World Artificial Intelligence Conference," September 17, 2018, http://www.mod.gov.cn/shouye/2018-09/17/content_4825134.htm.

34 UN Office for Disarmament Affairs, *Securing Our Common Future: An Agenda for Disarmament*, 2018, https://www.un.org/disarmament/sg-agenda/en/.

About the Author

The China Arms Control and Disarmament Association (CACDA) is a nonprofit, nongovernmental organization (NGO) founded in August 2001 in Beijing. CACDA undertakes the organization and promotion of academic research and nongovernmental activities at home and abroad in the areas of arms control, disarmament, and nonproliferation so as to facilitate international endeavors for world peace and security. The association was granted NGO in Special Consultative Status with the Economic and Social Council of the United Nations in 2005.

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