China's Military Employment of Artificial Intelligence

and Its Security Implications

Jiayu Zhang

Jiayu Zhang is a candidate in the Master of Arts Security Policy Studies program at the George Washington University's Elliott School of International Affairs. He received his undergraduate degree from the School of International Relations and Public Affairs at Fudan University. His research interests cover international security, nuclear strategy, military innovation, and the interaction between emerging technology and security. His recent research subjects include great powers' employment of private military contractors, AI's impact on military affairs, potential conflict in the Taiwan Strait, and overseas military bases in the modern era.

ABSTRACT

China's application of artificial intelligence (AI) technology has complicated and subtle implications for international and regional security. To take advantage of AI's structural and systematic advantages in technological innovation, China has launched a national campaign to allocate resources to AI development in both the public and private sectors. Other measures, including educational programs, "going out" strategy, and military-civil fusion, have also been implemented to bolster AI innovation. To prepare for "intelligentized" warfare in the future, the People's Liberation Army (PLA) is capitalizing on AI technology to develop unmanned intelligent combat systems, enhance battlefield situational awareness, conduct multi-domain operations, and promote training programs. The PLA has previously implemented structural reform and adapted doctrine to ensure its employment of AI fits the requirements for future warfare. China's progress in AI and its military application may trigger regional competition for AI primacy or an AI arms race, posing an ambiguous effect on arms control concerning autonomous lethal weapon systems. PLA's efforts to enhance nuclear capabilities by leveraging AI will have both stabilizing and destabilizing influences on strategic stability and nuclear risk. Ultimately, the introduction of AI to modern battlefields may help China tip the military balance in the Western Pacific, but its potential to change the essence of armed conflict and conduct in war is limited.

INTRODUCTION

Artificial intelligence (AI), with its potential to improve the speed and accuracy of everything on the battlefield, is heating up as a key area of strategic competition and driving militaries around the world to accelerate research and development for this revolutionary technology.[1] Among them, China not only intends to seize the initiative to become the "global AI leader", but also has unparalleled potential to capitalize on the application of AI to military affairs, which have complicated and subtle implications for international and regional security.[2]

The Chinese leadership intends to take advantage of AI to enhance its economic competitiveness and military capabilities. The New Generation Artificial Intelligence Development Plan lays out a comprehensive blueprint for the development and innovation of AI technology in both private and public sectors. The national strategy of military-civil fusion creates a favorable environment for the rapid transfer of progress from the private sector to the military context.[3] The latest defense white paper also highlights the importance of AI for the PLA by regarding "the integrated development of military intelligentization" as part of a characteristically Chinese way to strengthen the military.[4]

However, given the significant uncertainty about the pace and trajectory of AI innovation,[5] it is still hard to predict how AI might contribute to various kinds of military power, and to what extent. More importantly, the impact of any technology on military affairs depends principally on how people and organizations decide to use it.[6] Whether this intelligentized technology can be integrated into PLA's organizational structure and combat doctrine will shape China's military posture and security strategy on issues such as defending territorial claims in the South China Sea and unifying Taiwan by force if necessary. Since China's rapid build-up of its conventional military capabilities and growing regional ambitions have already triggered the concerns of peripheral countries, the implication of China's significant AI research and application in the defense field deserves more attention.

To explore these understudied questions, this paper focuses on how China's development of AI technology and its military application of such technology will influence security and conflict in the region. The next section of this article examines China's structural and systematic advantages as a totalistic party-state by briefly reviewing China's current measures and policies, such as launching a nation-wide campaign, cultivating talent, and encouraging "going out" to promote AI innovation. The subsequent section discusses China's efforts to apply such technological advances to the military field. AI has been used to develop unmanned combat systems, facilitate battlefield situational awareness and decision-making, conduct multi-domain operations, and promote training.

The last section discusses the implications of Chinese military's employment of AI for the balance of power, arms race, and strategic stability in East Asia.

CHINA'S NATIONAL AGENDA AND POLICIES FOR AI DEVELOPMENT

The use of AI technology has become a national development strategy for China. China's holistic approach to acquiring AI technology includes: (1) Issuing a national-wide campaign to mobilize resources, (2) deploying educational and academic efforts to cultivate a talent pool, (3) promoting "going out" to acquire knowledge abroad, and (4) requiring technology transfers with foreign companies. Finally, China is harnessing its structural and systematic advantages as a one-party, totalistic country to focus on its scientific and technological development.

1. National Campaign for AI Research and Development

On many occasions after his ascension to power, President Xi Jingping renewed urgency for demands that China master new technology,[7] arguing that "scientific and technological strength determines changes in the world balance of political and economic power, and determines the fate of every nation."[8] Among a variety of emerging technologies, Chinese leadership started to pay attention to AI and made it a national priority in 2015.[9] Within the past several years, multiple national science and technology strategies and plans have been issued, constituting a nation-wide campaign aimed at occupying the "high ground" of AI technology.[10] [11] With the guidelines provided by such documents, both public and private sectors are mobilizing to participate in the AI campaign.

The governments on national, provincial, and municipal levels have increasing financial and policy support for state-owned laboratories.[12] Most of those labs are affiliated with China's leading universities such as Tsinghua University's State Key Laboratory of Intelligent Technology and Systems, as well as the Chinese Academy of Science's Key Laboratory of Intelligent Information Processing. Moreover, various AI professional organizations and think tanks, similar to the Chinese AI Association and AI Industry Alliance, have been established with governmental sponsorship to promote the domestic exchange of AI expertise.[13] Motivated by both economic incentives and political urgency, private enterprises in the AI field are engaging actively as well. As of 2018, there were 4,040 AI companies in China. Among them are China's three largest internet giants, Baidu, Alibaba, and Tencent, which have collectively invested a total of $12.8 billion in the AI industry, surpassing the combination of the four leading U.S. firms.[14] Cooperation between public sectors and private companies is also encouraged. Under the leadership of Baidu, China's National

Engineering Laboratory of Deep Learning Technology was founded in 2017 to research machine-learning-based visual recognition, biometric identification, and human-computer interaction.[15]

2. Cultivating Talent Pools

To cultivate and recruit talent and expertise in AI, China has made various efforts in the educational realm. First, a structural transformation in China's higher educational system has paralleled the adaptation of the AI revolution in industrial sectors.[16] Already, 43 universities have dedicated new AI departments, with another 35 colleges receiving funds from the Ministry of Education in 2019 to offer AI as majors.[17] Academic conferences and seminars are held frequently to facilitate the diffusion and proliferation of AI know-how among Chinese academia. These efforts reflect a focus on taking advantage of China's sizable domestic human capital base to create a pipeline of talent for the future.[18]

Foreign material and human resources are being leveraged, as well. Thousands of foreign experts, typically university professors with specialties in different applied aspects of AI, are recruited through the "Recruitment Program of Global Experts" by Chinese institutions.[19] Partnerships with foreign universities and collaborative arrangements with foreign companies like the Fudan University-Google Technology Innovation Lab were formed. China was poised to "overtake the US in the most-cited 50% of papers" in 2019,[20] which displays the success of China's efforts to overtake the United States in AI research.

3. "Going Out" Strategy

In the process of building up indigenous capacity, China also continues to encourage its enterprises and students to pursue a "going out" strategy.[21] This approach includes overseas mergers and acquisitions, equity investments, venture capital, and the establishment of research and development centers abroad, as well as sponsorship of study abroad programs.[22]

Large investment consortia play a crucial role in funding Chinese and joint AI start-ups. According to CB Insights, China-based investors have engaged in tech investments amounting to $19 billion in the United States, across 641 different deals, with particular focus on AI, robotics, and augmented or virtual reality since 2012.[23] China's AI companies are also encouraged to maintain overseas labs in order to gauge local markets and access foreign research talent. Baidu, for example, runs a Silicon Valley AI Lab in Sunnyvale, CA, while Sensentime has an AI-based health lab in New Jersey and collaborates with MIT on machine intelligence. Chinese official agencies, like the China

Scholarship Council, in addition to the private sector also provide fellowships to students who enroll in foreign universities to pursue AI-related disciplines.

4. Technology Transfer

Technology transfer from foreign entities has been an important factor contributing to China's technological advancement. The major targets for China to acquire technology transfer are foreign companies that desire access to the Chinese market. To get access to Chinese consumers, foreign firms are required to either share their technology and patents or establish joint ventures with Chinese companies or the government; both methods allow China to gain the know-how it wants. Although China continues to take advantage of technology transfer, the role of China's growing domestic innovation capability is reducing its reliance on this approach.

5. Military-Civil Fusion

Given the dual-use nature of AI technology and the leading role of the private sector in AI innovation, the capacity of the PLA to take advantage of these technological advancements for military purposes is critical for its ambition to become the "world-class force".[24] Through the national strategy of military-civil fusion, the PLA can rapidly leverage the latest advances in civilian technological fields. This strategic agenda is directed by the Central Commission for Integrated Military and Civilian Development, which is headed by Xi Jinping himself.[25]

Under this framework, mechanisms for communication and coordination among scientific research institutes, universities, enterprises, and military industry units to share AI innovation resources are established and normalized. New joint laboratories are built as collaborations between civilian institutes and the military establishment. North China University of Technology and equipment departments of PLA's army, navy, and rocket force founded the Military-Civil Fusion Intelligent Equipment Research Institute.[26] Tsinghua University established its Military-Civil Fusion National Defense Peak Technologies Laboratory. Meanwhile, a selection of the latest AI-enabled products from private enterprises has already been procured and is currently being used by the Chinese military. For instance, PLA's surveillance and image processing systems are reinforced by intelligent security monitors produced by Hikvision.[27]

6. China's Structural and Institutional Advantages

China's rapid rise and future trajectory in AI could be enabled by policies mentioned above, which stimulate the potential of China's structural and systemic advantages. On a structural level, the totalistic system increases the ruling regime's ability to exercise control and direct the socioeconomic field.[28] Combined with the powerful mobilization capacity of the CCP, a huge amount of material and human resources is allocated to AI-related projects. Public institutes and private companies are ordered to concentrate their efforts on AI. To exploit synergies of this dual-use technology, close collaboration between academics, industry, and the PLA enables a critical edge for implementing and operationalizing the latest advances.[29] From a demographic aspect, China's huge population provides it with advantages on two dimensions: human resources and data resources. First, reinforced by educational arrangements, a giant human capital pool is being generated for AI talent recruitment. Second, the availability of massive amounts of data, which is crucial for machine learning, means that China has control of more than 20 percent of strategic resources in the information era.[30]

CHINA'S APPLICATION OF AI TECHNOLOGY TO MILITARY AFFAIRS

PLA strategists and academics have characterized current trends as the advent of a new military revolution, in which AI and related technologies are changing the metrics for military power. China's military application of AI includes, but is not limited to, developing unmanned intelligent combat systems, enhancing battlefield situational awareness and decision-making, conducting multi-domain offense and defense, and facilitating advanced training, simulation, and wargaming practices. More importantly, the PLA is undergoing organizational reform and doctrine adaptation to determine how to operate AI-enabled platforms and wage intelligentized warfare in an effective manner.

1. Unmanned Intelligent Combat Systems

Among the different military applications of AI, Beijing has placed the greatest emphasis on unmanned systems. The PLA is pursuing the development of intelligent unmanned vehicles, platforms, and weapons with the expectation that they will disrupt traditional ways to wage wars.[31] In recent years, many Chinese-designed unmanned vehicles and systems have been commissioned in the PLA. Multiple variants of the *Caihong* ("Rainbow," CH) family of high-altitude long-endurance unmanned aerial vehicles have been used for reconnaissance and strike missions. In October 2019, WZ-8, a high-altitude

super-speed stealth reconnaissance UAV, and Sharp Sword-*11*, a large stealth strike drone, was demonstrated during the military parade on National Day,[32] revealing PLA's rapid progress in developing intelligent UAVs. Moreover, an unmanned autonomous underwater vehicle, HSU-001, was also showcased in the parade.

In addition to designing high-performance unmanned systems, Chinese military strategists are exploring innovative ways to employ these weapons. Learning from the U.S. experience of deploying drones for air strike missions and without sufficient gunships, the PLA assigned UAVs to the company level of its ground forces to provide close air support. PLA scholars have also written on the role of unmanned systems in anti-submarine warfare, airborne operations, and amphibious landing missions.[33] [34] [35] The "swarming" concept has also been intensively studied to enable the collaborative operation of a large group of unmanned systems in a complicated electromagnetic environment.[36] Besides emulating the successful experience of advanced militaries, the PLA is also interested in pursuing anti-UAV countermeasures to offset the first-move advantage of other countries.[37]

The PLA may also incorporate AI to existing combat platforms, especially obsolete weapons, to build an "army of none". Thousands of China's retired second- and third- generation jet fighters like the J-7 and the J-8 can be modified to build an unmanned air fleet by installing AI-enabled self-navigation technology and autonomous combat systems that automatically pursue, distinguish, and destroy enemy targets. Given the air combat capacity of the original platforms, employment of such unmanned intelligent systems will not only take advantage of swarm systems' low cost and overwhelming scale, but also be superior to swarms consisting of normal drones. This approach gives the Chinese military a huge asymmetric advantage with which the PLA can eliminate strategic targets while avoiding high personnel losses.[38]

2. Battlefield Situational Awareness and Decision-making

Reinforced by AI-enabled technology, speed and accuracy can be enhanced in battlefield reconnaissance, surveillance, and communication; electronic inference and radar deception; combat assessment; and fire guidance.[39] As a result of the improvement of real-time situational awareness and decision-making on the battlefield, PLA's three basic warfare elements—shooting, communication, and movement,—will be significantly strengthened.[40]

First, the accuracy and frequency of weapon systems' firing will be enhanced by advances in situational awareness capacity. Applied AI technology such as image and voice recognition can be used for target detection and acquisition. Hikvision's surveillance cameras, which are able to identify potential adversarial targets automatically, may be installed on aerial weapons. By developing

deep-learning methods, intelligent missiles and shells can be produced to identify targets and their weakness, evade interceptors and conduct end-phase maneuvering, which will bolster both the first-strike and retaliatory capacities of the PLA. More importantly, intensive sensors facilitated by machine learning technology will process the intelligence they capture at a flashing speed so that the time between identifying targets and attacking targets is radically reduced, increasing the rate of fire.[41] In other words, situational awareness capabilities strengthened by AI will not only accelerate the traditional OODA loop but also make a "storm of steel" fired by autonomous vehicles and intelligent weapons possible.

Second, installing AI systems will change the way PLA moves and maneuvers on the battlefield. In a world that is becoming one giant sensor, hiding and penetrating will be far more difficult.[42] In such conditions, AI technology will help identify the weaknesses of enemy defense lines and improve routine planning by enhancing situational awareness capacity. With the intelligent analysis of geographic terrain and enemies' posture enabled by deep learning, PLA troops can determine the safest route to maneuver to the frontline and penetrate the opponent's defenses. Logistical support departments can manage unmanned platforms to more efficiently distribute supplies and materials based on real-time intelligence.[43] [44]

In terms of battlefield communication, AI technology is both an enabler and a beneficiary. On the one hand, intelligent distribution across the communication spectrum to maintain a complex electromagnetic environment secures the network connection among different combat branches. The development of intelligent electronic warfare equipment will help counter rival jamming and interference to communication.[45] On the other hand, with the ultra-high-rate, ultra-large-capacity, and ultra-low-latency of next-generation technology like 5G, data and orders can be transferred stably and quickly between the cloud and connection terminals. Future intelligent systems based on 5G technology can more efficiently collect, transmit, and process massive battlefield data, providing real-time data analysis results for commanders.[46]

Last and most importantly, the processing application of AI's super data fusion and intelligence analysis will help militaries more accurately and quickly interpret information,[47] which could enable the PLA to gain mastery of battlefield command and control (C2) and improve decision-making. In an era that is overloaded by the high volume of information, a new challenge facing the Chinese military is the effective processing of huge amounts of raw intelligence and the accurate interpretation of the real meaning behind information flows. Deep learning technology is likely to substantially increase the efficiency and accuracy of interpreting patterns in raw intelligence so that enemies' intents and actions can be better understood. The introduction of machine learning algorithms to the analysis process for satellite imagery and

other sensors can enable a "prediction revolution" that could support PLA's early warning capabilities.[48] For instance, AI start-up iFlytek's voice recognition and synthesis module technology are useful for communication surveillance and radio sensing.

3. Multi-domain Offense and Defense

While the United States begins to incorporate the concept of multiple-domain operations to its AirSea Battle doctrine to counter China's Anti-Access/Area Denial (A2/AD) capability in the Western Pacific,[49] China is also increasing its focus on cultivating versatile capacity in unconventional domains and strengthening cross-domain deterrence. With the reinforcement of AI, both offensive and defensive capabilities of the Chinese military on nuclear, cyber, and space domains will be consolidated and improved.

China regards nuclear capabilities as one of the pillars of great powers. Applied neural networks and machine learning can bolster the PLA's offensive and defensive capabilities in the nuclear domain. According to SIPRI's survey, China's domestic and international cross-institute collaboration in the pursuit of the benefits of integrating neural networks with hypersonic glide vehicles has become increasingly common.[50] Such applications, including automatic target recognition, auto-piloting, missile fusion, and precision guidance for hypersonic platforms, will enhance the maneuverability and penetration capacity of nuclear missiles, thereby reshaping conventional and nuclear deterrence dynamics.[51] On the defensive side, the situational awareness capacity enhanced by AI technology can strengthen China's nuclear retaliatory capabilities by improving early-warning and missile defense systems. Operating at machine speeds through the deployment of autonomous interception systems can protect nuclear arsenal and missile bases when facing saturation strikes.[52] Application of automation-enabled launch-on-warning to its missiles can strengthen the credibility of China's retaliation and the principle of mutual vulnerability it seeks.[53]

The PLA seeks to leverage big data analytics, machine learning, and automation to enhance the defense of critical military and civilian networks and scale the effects of offensive cyber operations.[54] The victory of AlphaGo inspired Chinese strategists; since well-trained AI programs can innovate new tactics in go games, they should also be able to create new, previously unimaginable ways to conduct cyber-attacks. The offensive advantage in cyberspace stems from the limitation of human logic to detect systemic weakness. However, by utilizing technology such as pattern recognition and deep learning, AI can not only be helpful for detecting the vulnerability of enemies' networks but can also assist the protection of friendly systems by detecting loopholes that need to be fixed. The PLA's Strategic Support Forces' (SSF) Information Engineering University

has developed methods to identify and mitigate Distributed Denial of Service attacks through pattern matching, statistical analysis, and machine learning. A prediction path for cybersecurity based on deep learning has been formulated by researchers from the National University of Defense Technology.[55] Further, the PLA can profile targets and customize operations to shape, guide, and control individuals' ideas and emotions based on intelligent analysis, which can be advantageous in psychological warfare.[56]

4. Training, Simulation, and Wargaming

The PLA will likely take advantage of AI to increase the sophistication of its simulations, war-gaming, and drills.[57] Due to the lack of opportunities for Chinese commanders and soldiers to gain actual combat experience, the PLA's new combat-oriented training places great emphasis on simulation and software-based wargaming. More importantly, the PLA is accustomed to investigating emerging concepts and testing new weapons through simulation. Therefore, the PLA has great incentive to integrate AI technology with its computerized wargames and military simulators to "enhance the level of realism and create an artificially intelligent 'Blue Force'".[58] In recent years, several wargaming contests involving human-machine confrontations have been held by the National Defense University's Joint Operation College and the National University of Defense Technology's Systemic Engineering Department.

5. Organizational reform and doctrine transformation

Emerging technologies only make military revolution and ascension of military capabilities possible. To realize their full potential, these technologies must be incorporated into new processes and executed through a new organizational structure. In the case of Chinese military, its organizational reform launched in 2015 and doctrine adaptation may ensure its employment of AI technology is fitting for the future of intelligentized war.

First, the PLA underwent a comprehensive reform of its force structure, which can reshape its capability to win intelligentized warfare. The most significant measure has been the establishment of its SSF. According to the Chinese Ministry of Defense, SSF "comprises supporting forces for battlefield environment, information communications, information security, and new technology testing."[59] In intelligentized warfare, the SSF would operate AI-enabled platforms to provide other branches of the Chinese military with sound situational awareness and support decision-making through rapid intelligence processing. As the new basic combat unit among PLA ground forces, integrated brigades distribute strategic support teams at the battalion level. These teams are responsible for operating UAVs and other intelligent systems to enhance

the intelligence, surveillance, reconnaissance, and long-range strike capabilities of small units. Furthermore, the Chinese military also reorganized its affiliated research institutes and military universities and adjusted its recruitment policy to realize better management and allocation of human capital.

When it comes to combat doctrine, the adaptation is moderate. One observer argues that the PLA "could prove less averse to the prospect of taking humans out of the loop" because "Chinese discussions about keeping a human in the loop in technical writings remain limited to nonexistent."[60] However, the PLA's way of fighting is rooted deeply in a strong strategic culture arguing that human beings are the ultimate determination of war. Although new concepts like "intelligence dominance" and "algorithm-centric warfare" have appeared in official military writings recently, the PLA is still forming a coherent doctrine that mitigates the conflict between AI's trend to keep humans out of the loop and its own military culture emphasizing the role of humans.[61] In fact, some patterns of AI-based combat align with Chinese approaches to war. For instance, swarm tactics, which use a large amount of low-cost unmanned systems to saturate enemies, are similar to the guerilla tactics that the Chinese troops used in WWII.

It should be noted China's weaponization of AI is also occurring in the information and psychological domain. The PLA's strategists have begun to discuss how to win on cognitive dimension and seize "metal/cognitive domination" (制脑权) in future warfare.[62] On the one hand, polymeric technology, which combines brain science, biological technology, and artificial intelligence, will not only improve soldiers' cognitive ability but also create an effective brain-machine interface, which may make some sci-fi super soldiers possible. Additionally, advanced intelligent algorithms can be used to fight a war in the realm of propaganda. By promoting domestic cohesion through the control of public opinion and disruption of opponents' efforts to influence the Chinese press, AI will engage this new dimension of the "people's war" in the information era.

SECURITY IMPLICATIONS OF CHINESE MILITARY'S EMPLOYMENT OF AI

China's development of AI and its application of such technologies to military affairs impacts on many regional and international issues. This article focuses on the Western Pacific, where most of China's major security concerns and the potential flashpoints for future military confrontation are centered. For a region that is already tense and crowded, a regional competition for AI primacy may trigger an AI arms race and pose an ambiguous effect on arms control concerning autonomous lethal weapon systems. The PLA's efforts to enhance nuclear capabilities through AI will have both stabilizing and

destabilizing influence on strategic stability. Ultimately, the introduction of AI to the modern battlefield may help China tip the military balance, but its potential to change the essence of armed conflict and the way in which war is waged is limited.

1. Arms Race and Arms Control

Some voices in China are calling upon the Chinese government to avoid an AI arms race. While it is hard to define whether the struggle for technological primacy fits the definition of an arms race, the competition among actors in the Western Pacific for advanced AI technology has already intensified. South Korea has allocated many resources to research AI-based command systems, aviation training systems, and object-tracking techniques.[63] Other efforts made by Seoul to militarize AI technology include works on the Exobrain and ADAMs projects for the potential enhancement of C4ISR, virtual combat exercises, and self-navigation algorithms.[64] Even though its general technological capabilities are nascent, North Korea engages in the competition by focusing on some aspects of AI that can be used to elevate its current military operations. It has been suggested that Kim Il Sung University and the Korea Computer Center have advanced the Ryongnamsan 5.1 speech-recognition systems, audio classification, and deep fakes to reinforce cyber aggressions.[65]

China's rapid progress in AI and its military application have encouraged such competition and may trigger a potential arms race in two ways. First, the PLA's increasing military power facilitated by its application of AI technology has already activated a security dilemma, especially concerning China's increasing assertiveness in territorial disputes and growing ambitions about the regional order. The PLA's employment of AI-enabled early-warning systems and unmanned intelligent combat vehicles will enhance China's awareness of Japanese and South Korean operations in disputed areas like the Senkaku Islands and enable a quick response capability. From the perspective of other countries in the region, China's willingness to escalate in such scenarios will increase because its AI technology would provide it with a decisive advantage in a conflict with limited costs, despite increasing the potential of accidental escalation.[66] Other countries' have begun to pursue more defense measures, a move that reflects concern about China's potential threat, including the development of weapon-grade AI technology. Such defensive measures suggest that tensions triggered by the security dilemma in the region will be more complicated and expand beyond an AI arms race. Nuclear proliferation, targeting civilian infrastructure that supports AI technology, and more cyber aggression may be seen in this context.

Second, China's success in influencing U.S. strategic calculation and military posture by military employment of AI may encourage other countries

to copy its success. Other countries who see themselves as adversaries of the United States may be motivated to increase AI investment and attempt to install related technology to their missiles to exercise coercion and threats. For U.S. allies like Japan, the introduction of AI in early-warning, situational awareness, and intelligence processing may not only help reduce reliance on U.S. extended deterrence, but also strengthen their ability to counter regional rivals like China and North Korea.

Thus, the proliferation of AI technology, especially those can be weaponized, poses challenges to the arms control community in the region. Given the highly dual-use nature of AI, civilian AI technology cooperation between countries may contribute to the unintentional proliferation of destructive AI systems, a situation which is similar to the dual-use dilemma of nuclear cooperation.[67] On the practical level, weapon-, behavior-, or country-focused controls will face different problems ranging from how to define controlled weapons to how to verify the control measures.[68] On the political level, countries' attitudes toward AI arms control are ambiguous. In 2018, China demonstrated its "desire to negotiate and conclude" a new protocol for the Convention on Certain Conventional Weapons to ban the use of autonomous lethal weapons systems.[69] However, the delegation stressed that the ban should only apply to the use of such weapons, and not to their development, revealing China's actual misgivings regarding arms control for autonomous systems.[70]

2. Strategic Stability and Nuclear Risk

Nuclear strategic stability is understood as "a state of affairs in which countries are confident that their adversaries would not be able to undermine their nuclear deterrence capability" using nuclear, conventional, cyber or other means.[71] Given the dynamics of nuclear posture of major powers in the region and the potential role of nuclear escalation in certain scenarios, AI-enabled improvement of the PLA's multi-domain operation capabilities has both destabilizing and stabilizing impacts on strategic stability.

China has long been concerned about false negatives from its early warning systems, which may result in failures to detect nuclear attacks.[72] To some extent, such concerns are rooted in China's assumptions about its own early warning deficiencies and its own inability to counter a stealthy and prompt precision strike from the United States.[73] Regarding China's employment of nuclear weapons, military-technology considerations stressing the plausible U.S. conventional military operation against Chinese nuclear capabilities are the reasons behind China's use of limited nuclear escalation.[74] As a result, if China gains greater situational awareness and can strengthen its nuclear retaliatory capabilities by applying AI technology to its C4ISR and early-warning systems, some of its insecurities about a "bolt-out-of-the-blue" strike

may be mitigated, which will stabilize the nuclear risk.[75]

Yet China's insecurities are not simply a question of technology. The key factors are China's perception of U.S. nuclear posture and its assumption of U.S. intent. In this sense, China's use of AI and autonomy for nuclear offense and defense could take on destabilizing qualities. For Beijing, the prospect of the United States resuming a forward-deployed, tactical nuclear posture exacerbates its sense of encirclement. The issuance of the 2018 U.S. Nuclear Posture Review worsens the context. China views the documents' focus on ballistic missile defense and conventional prompt global strike as preemptive and destabilizing.[76] Additionally, the proposal for the enlargement of the U.S. arsenal of low-yield submarine-launched ballistic and cruise missiles and the concept of using nuclear coercion to preemptively de-escalate a conventional conflict like Taiwan scenario further elicit Chinese concerns over U.S. intent. AI and autonomous technology offer Beijing the potential to respond to such a posture. China could deploy swarms to track and intercept U.S. dual-capable platforms. Whether intentionally or unintentionally, an escalatory scenario could develop. While the PLA's deployment of advanced AI-enabled early warning systems and automation-enabled launch-on-fire missiles may mitigate China's fear of false negatives, it may intensify U.S. concerns about false positives,such as a nuclear war caused by accidental fire or false detection.

3. Military Balance and Future Warfare

AI is helpful for enhancing battlefield situational awareness, especially reconnaissance, surveillance, and target acquisition (RSTA) technology;[77] a key element for the PLA's A2/AD capabilities. China's military application of AI technology will not only reinforce the RSTA component of its A2/AD system but also add a new dimension to the implementation of this strategy.

According to Biddle and Oelrich, military advantages provided by A2/AD are only strong over controlled landmasses and weaken over greater distances due to the change of "RSTA's effectiveness with the complexity of the background against which it must detect targets."[78] For instance, the effectiveness and detection range of radar, which is "the most robust solution to the demands of sensing mobile targets over wide areas,"[79] is limited by multiple elements ranging from Earth's curvature to its defenders' survivability. Mobile sensors like early-warning aircraft and seaborne radars are almost exposed to enemies' fire because of the low-complexity of their background. While such RSTA systems' effectiveness decreases when far away from landmasses and makes them vulnerable to enemies' attacks, the capabilities of A2/AD's fire solutions, like long-range missiles, will be dramatically weakened. Nevertheless, AI technology offers methods to solve these problems. First, rapid data processing reduces the time needed for radars to maintain operating status.

Vulnerable sensors can be shut down and concealed before enemy firepower approaches. Second, fixed high-power radars are no longer the only solution for long-range RSTA. Swarms of intelligent UAVs and UUVs can be sent to open airspace and sea to conduct reconnaissance missions. Every vehicle in such a system is an intelligence-gathering and analysis hub, which means collection and processing can be finished on the same end. This unmanned tactic is superior to the traditional OODA-style way of fighting in terms of low cost and high efficiency. Furthermore, unmanned intelligent combat systems like modified unmanned J-8 can replace long-range missiles strike to be the main strike choice. Combined with other technological progress, like a new aircraft carrier that uses electromagnetic launch systems to allow quick delivery of UAV fleets, the PLA's A2/AD capabilities will be significantly strengthened and might ultimately help China realize its ambition for regional "command of the commons".[80]

This trend of increasing Chinese military power resulted from the application of AI to the national defense field; however, it will not change the essence of armed conflict and the methods of waging war. AI itself is an enabler, like a combustion engine and electricity, as opposed to a weapon.[81] The function of AI in military affairs is to enhance the capacity of existing systems and platforms in terms of speed and efficiency, rather than "turning a stone to a gold". AI can speed up war, but it cannot change the essence of war.[82] As a result, the nature and performance of original weapon systems still matter. More importantly, wide deployment of AI-based systems still faces some serious challenges. First and foremost, a huge volume of high-quality data is required to train AI algorithms and enable machine learning. On the one hand, war-related data is sensitive and not easy to access. On the other hand, it is very difficult to code some elements of warfare into machine-readable quantitative data. Second, when AI algorithms run at flash speeds, it is extremely challenging for other military hardware to keep up with them. To make sure those hardware can keep pace with AI programs, stable ultra-speed communication and comprehensive data-link networks are indispensable. The PLA still needs to enhance the interconnectedness among its units and organs, develop next-generation communications technology, and establish reliable and secure data links. These requirements echo China's prioritization of 5G, block chain, and quantum computing. Furthermore, radical advance and improvement in basic physics and machinery engineering should be achieved to optimize the performance of original hardware. Third, scientists still find it challenging to understand the behavior of AI, creating a risk of unreliability.[83] Armed forces like the PLA, which take such issues very seriously, will be very cautious in the deployment and employment of AI-based systems if they cannot ensure their battlefield reliability and political loyalty.[84]

ENDNOTES

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