FEATURE

Artificial Intelligence Technology and China's Defense System

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Artificial intelligence (AI) technologies have been developed for many years and applied in various areas. Applications of AI exist not only in domestic surveillance but also in military uses. AI-related topics have become even more controversial and attracted more attention where China, a nation with rapid growth in its military development, is involved. This article introduces China's rapid AI progress, demonstrates possible application areas of AI technologies in China, and analyzes the likelihood for China to wage a war with its AI technologies.

Background and General Applications of Artificial Intelligence

AI is regarded as part of the Fourth Industrial Revolution, which also includes the Internet of Things, genetic engineering, quantum computing, and so forth. Russian president Vladimir Putin once said that "artificial intelligence is the future, not only for Russia, but for all mankind. Whoever becomes the leader in this sphere will be the ruler of the world."[1] The Trump administration launched the United States' first national AI strategy. After Pres. Joe Biden took office, he invested around $6 billion into AI-related research projects.[2] Attitudes toward AI from Russian and US leaders, as well as remarks of commercial tycoons such as Eric Schmidt and Elon Musk, reflect the importance of AI, and its potential dangers, too.[3] Development of AI is crucial in areas such as human resources, the public sector, medical care, and even in the military field.

AI is an enabling technology, rather than a type of weapon. Enabling technologies are designed for general purpose, such as the internet and electricity, and do not work for any single purpose—making them different from transportation and other similar technologies. AI can be applied in many field: i.e., natural language generation, speech recognition, virtual agents, robotic processes automation, and so forth. Michael Horowitz points out that AI can be operated in several dimensions.[4] First it can be used as a system to supervise objects, such as planes and tanks, to reduce the need for human oversight. Second, AI can be adopted to process and interpret information; image recognition is a practical example of this. Third, an overlapping AI system could be used both for command and actions. AI is dual-use for civil and military, and later sections in this article will focus on mainly its military aspect.

China's Development of AI Technologies and Military Applications

The *Final Report* released by the US National Security Commission on Artificial Intelligence in 2021 describes China as a "competitor," if not a leader, to the United States in terms of AI development. A basic understanding of the US-China AI competition is established in the report: ". . . we must win the AI competition that is intensifying strategic competition with China. China's plans, resources, and progress should concern all Americans. It is an AI peer in many areas and an AI leader in some applications. We take seriously China's ambition to surpass the United States as the world's AI leader within a decade."[5] The report also foresees China's determination to surpass the United States in AI leadership with its talent and technological development. This section demonstrates the area of China's AI development and applications.

Before digging into the military aspects, the reason China has been devoted into AI should be explained. In 2015, China issued the document *Made in China 2025* and two years later in 2017, China released the *New Generation Artificial Intelligence Development Plan*. These two documents proved that China's central government officially confirmed the importance of developing AI technologies. The primary purpose of China's AI development is for domestic use. First, advanced technologies are the major driving force for the economic and commercial development in China. To maintain its rapid growth, China encourages high technologies research and development, including AI, thus many private firms and research institutions have entered this field. Second, AI has been adopted domestically to improve the overall well-being, for example, payment using facial recognition, online AI-driven medical diagnosis, and security cameras that are designed to enhance safety.

China's determination of developing AI technologies is not supported only by documents but also practice. The Ministry of National Defense has established research institutions—the Artificial Intelligence Research Centre and the Unmanned Systems Research Centre—to focus on AI and unmanned systems research and development. The key military think tank, the Academy of Military Science (AMS), has also updated its doctrine to cope with the AI technological development: "The revamped AMS is tasked with driving defense innovation and ensuring that the People's Liberation Army's (PLA) warfighting theory and doctrine fully capitalize on disruptive technologies like AI and autonomous systems."[6] In addition to the government-backed official organizations, a number of private institutions have also invested considerable sums of money to conduct related research. The central government of China uses the term "intelligentized" warfare to refer to the innovations in military technologies.[7] Ryan Fedasiuk, Jennifer

Melot, and Ben Murphy analyzed more than 300 AI-related equipment contracts of the PLA regarding the adoption of AI technologies, and the result of their research shows that around 2 percent of PLA contracts are related to AI in the half year from April to November 2020. The research also predicted that China would continue to invest in AI technologies and may create vulnerabilities for the United States. Moreover, to quickly transfer technologies from the private sector to the public, China also launched a national strategy, the military-civil fusion, to create a favorable research and development environment.[8]

Among all the AI technologies, China places the top priority on unmanned combat systems and equipment along with other advanced military innovations.[9] Unmanned technology has been profoundly changing the face of warfare, and unmanned equipment is one of the first options for future combat equipment. Since President Xi Jinping took office, he has emphasized the importance of unmanned systems on various occasions. For example, in 2017, when Xi Jinping visited the training of unmanned operations, he said to the sergeant that "UAVs are important combat forces for the modern battlefield. You must carry out your duties well and cultivate good personnel."[10] Another example was in 2020, when Xi met students at the Chinese People's Liberation Army (PLA) Air Force Aviation University, he declared, "Drones are profoundly changing war scenarios. It is necessary to strengthen drone combat research, education and training, and accelerate the training of drone pilots and commanders."[11] The capacities of unmanned combat systems include effectively reducing casualties, achieving accurate reconnaissance, striking, resupplying, configuring flexible activities, and significantly improving combat effectiveness—to list only a few of many such advantages. With the development of unmanned technology, human warfare places more and more value upon information, which AI and unmanned systems excel at procuring.

China's development of unmanned aerial vehicles (UAV) began in the late 1950s.[12] In 1959, it had basically figured out the law of self-pilot takeoff and landing of two types of aircraft, namely the An-2 and IL-28. In the mid to late 1960s, China had been investing in the development of UAVs and formed a series of target aircraft such as the Changkong-1 radio-controlled target UAV, the DR-5 high-altitude photo reconnaissance aircraft, and the D4 small remote-controlled aircraft. Moreover, in August 1958, the first unmanned aircraft developed by Northwestern Polytechnic University flew successfully, and in 1984, the university established the UAV Research Institute with the approval of the former Ministry of Aviation Industry. In the1970s, China developed ChangHong high-altitude high-speed unmanned reconnaissance aircraft, T-6 general-purpose unmanned aircraft, Z-5 series unmanned reconnaissance aircraft, ASN series unmanned aircraft, and so forth. Dozens of these target and reconnaissance UAVs have been

mass-produced and deployed alongside troops. The emergence of a large number of Chinese military UAVs began in 2006, when a number of military UAV designs appeared publicly in the limelight, such as the "Xianglong" high-altitude high-speed unmanned reconnaissance aircraft, whose body design is very similar to the US "Global Hawk" high-altitude long-endurance reconnaissance UAV; the "Skyhawk-3" unmanned helicopter that can hover, take off, and land vertically; and the "Dark Sword" UAV shaped like a US-made stealth bomber, which can burst into the enemy's airspace with its stealth and high-speed performance and conduct suppressive attacks on the enemy's air defense forces.[13]

The PLA is equipped with at least four types of medium and large UAVs, namely the EA-03 Xianglong, the Attack 1 (Wing Dragon 1), the JWP02 (ASN-206), and the BZK-005 UAV.

- EA-03 Xianglong is China's most advanced high-altitude long-endurance unmanned reconnaissance aircraft in service. With a status similar to that of the US RQ4 global-use UAV, it is mainly adopted for high-altitude strategic surveillance reconnaissance. The aircraft has an overall length of 14.33 meters, a wingspan of 24.86 meters, a normal takeoff weight of 6,800 kilograms, a mission load of 600 kilograms and an effective flight range of 7,000 kilometers. It can conduct continuous aerial surveillance for 10 hours at an altitude of 18,000 meters from 2,000 kilometers away. The front and rear wings are connected in a diamond shape, which greatly strengthens the stiffness of the wings with a certain stealth capability.[14] During the standoff in Dong-Lang in the in last year between China and India, three Xianglong aircraft had appeared at Shigatse airport, and this confirmed that troops have been equipped with the aircraft.
- The Attack-1, improved from Chengfei Institute's Yilong-1 (sometimes call the Wing Loong), was unveiled at the 2014 Zhuhai Airshow and was the first active PLA inspection and fighter UAV that was made public at the airshow. Its shape is similar to that of the US UAV MQ-9, while its size is similar to that of the MQ-1 Predator. It has a maximum takeoff weight of 1.2 tons, a length of 9 meters, a wingspan of 14 meters, a payload of 200 kilograms, a maximum lift of 5,300 meters and a range of 4,000 kilometers. The latest Yilong-2 has a major improvement in both size and performance, with a length of 11 meters, a wingspan of 20.5 meters, a maximum flight altitude of 9,000 meters, a maximum speed of 370 kilometers per hour, a maximum takeoff weight of 4.2 tons, and an external hang-up capacity of 480 kilograms. It is equipped with synthetic aperture radar (SAR) as well as laser-guided missiles and GPS-guided bombs and is able to perform con-

tinuous missions for 20 hours. To date, there has been no news that the Yilong-2 has been put into service.[15]

- The JWP02 UAV (ASN-206) was developed by the Xi'an Aisheng Group of Northwestern Polytechnic University and won the first prize of the National Science and Technology Progress Award in 1996. It is rumored that it had received technical support from Israel. The aircraft applies solid rockets in assisting flight, zero-length launch, parachute landing and recovery, and can be used multiple times. It has a maximum takeoff weight of 222 kilograms, mission equipment weight of 50 kilograms, practical lift of 6,000 meters, range of 150 kilometers, and endurance of four to eight hours. The aircraft, which was developed earlier than Attack-1 UAV, currently serves as the mainstay of China's tactical unmanned reconnaissance aircraft along with the Attack-1 UAV.[16]
- BZK-005 UAV has certain stealth capability and is a medium and high-altitude long-range unmanned reconnaissance aircraft. It has a maximum lift of 8,000 meters, an endurance of 40 hours, a maximum takeoff weight of 1.25 tons and a maximum carrying weight of 150 kilograms. Early models are equipped with photoelectric pods, while the latest models are equipped with SAR and other electronic reconnaissance equipment. The media reported that the aircraft has been on a patrol flight mission in the East China Sea. The TYW1 Skyhawk UAV, which was developed on the basis of the BZK-005, rolled off the production line on November 14, 2017. It is reported that the maximum takeoff weight of the TYW-1 has increased to 1.5 tons, with a maximum bomb load of 300 kilograms.[17]

UAVs play three important roles in military applications, the first of which is reconnaissance and surveillance.[18] UAVs can penetrate hundreds of kilometers or more behind enemy lines and are configured at high, medium, and low altitudes. They can provide important reference for strategic decision-making and battle command in large-scale military operations through scanning reconnaissance and close-in reconnaissance to obtain highly accurate intelligence information. The latter is very suitable for PLA military, divisional, and brigade-level forces of the PLA Marine Corps to conduct battlefield reconnaissance surveillance, target search and location, as well as battle results assessment. UAVs can also work with satellites and skywave over-the-horizon radar to search and track enemy maritime targets and transmit back target information in real time. In this way, military UAVs can become an important part of the "kill chain" in antiaircraft-carrier warfare. The second is electronic jamming.[19] Electronic-jamming UAVs can fly over the enemy, emitting electromagnetic waves through their airborne equipment and

the application of interference foil, and so forth to implement interference on the enemy's air defense radar, fire control radar, early warning systems, and other electronic equipment to cover China's aircraft defense and ground attack. The third role is firepower destruction. In addition to antiradiation UAVs that can destruct the enemy's radar and other electromagnetic equipment, attack UAVs, inspection and fighter UAVs, and so forth can also carry out effective firepower destruction against the enemy.

Acquisition of UAV technologies has enhanced China's confidence to conduct reconnaissance and surveillance tasks to protect claimed territory. In the early 2010s, China for the first time sent a UAV to the Diaoyu Dao/ Senkaku Island disputed area.[20] It was able to easily avoid the detection of Japanese ground radar, which surprised the Japanese coast guard. It was only a short and tactical victory that the Chinese UAVs exploited the loopholes in Japan's air defense system and reached the Diaoyu Islands for cruising with an ultra-low-altitude blind spot; it did not change the strategic pattern of the Japanese side's effective control over the Diaoyu Islands.

The most common unmanned aircraft to cruise the Diaoyu Islands is the BZK-005 unmanned reconnaissance aircraft—equipped with a rear-propelled engine, a dual-tail brace structure and an under-nose photoelectric/infrared detection device—first unveiled at the Zhuhai Airshow in 2006 and capable of flying continuously for 40 hours at an altitude of 26,000 feet.[21] The BZK-005's primary detection system is an electro-optical pod under the nose, which is equipped with a forward-looking infrared detection system, CCD cameras, and a laser range/target designation system. Wave-transparent materials are applied in the BZK-005 UAV; thus, it can be determined that it has a satellite communication system that can transmit information to the rear over radio range, which also indicates that the BZK-005 should have an activity radius of more than 1,000 kilometers. The application of the BZK-005 UAV has effectively enhanced the capability of China's naval maritime integrated surveillance system. At present, the quantity and quality of China's naval maritime surveillance aircraft are insufficient, and the application of the BZK-005 can improve the capability and coverage of China's naval target detection and indication system, especially for accurate detection and identification of targets in the middle and near sea, which helps China to comprehensively grasp the real-time situation in the relevant sea areas and provides support for relevant decision making.

For nearly a decade since China sent the BZK-005 to the Diaoyu Island area without alerting Japan, Japan has been cooperating with the United States to equip itself by importing UAVs. Early this year, Japanese media reported that the United States and Japan are currently discussing a military deployment against

China. According to the report, the United States and Japan plan to deploy MQ-9 UAVs near Kagoshima, a move designed to "respond to China's" regular military operations.[22] UAVs are characterized by high speed and high altitude. The MQ-9 made its first flight in 2014 after improvements were made, and then it was used by the US military. It is understood that the UAV deployed in Kagoshima is a reconnaissance type and it is also the first time the United States deployed this high-altitude type of UAV in Japan.

With the US pivots in Asia, tensions between the two giants, namely China and the United States, have been inevitable. Located in the southwestern tip of Japan, Kagoshima has a very special geographical location in that, if the United States deploys the MQ-9 UAV on the island, it will obtain the information about the activities of the Chinese naval fleet. In other words, the MQ-9 UAV is the US "eye" planted in the vicinity of China for receiving information. In addition, the specific location of the US deployment of the MQ-9 UAV is also thought-provoking, for the reason that to the further south of Kagoshima, there are the Okinawa Islands, followed by the Miyako Strait waters. This area is the "treasure land" that is of great military importance. When the United States and Japan intervenes in the Taiwan Strait conflict, should it occur, the Miyako Strait waters are the shortest cut they must go through. Obviously, China is also aware of this problem. Therefore, China should pay close attention to the Miyako Strait when the cross-strait unification attack commences, if this is the only way. In this context, the US UAVs deployed in Kagoshima are the main means of reconnaissance for the United States and Japan. The UAVs must not only watch out for the moves of the Chinese side, but also conduct reconnaissance of Chinese defense networks.

UAVs are not only used in the East China Sea area, but also the South China Sea area. Even in the border conflicts between China and India, UAVs were also applied. Despite that there has not been any offensive action taken by UAVs in the mentioned areas, one cannot deny the potential there. Considering the unstable situation in the Indo-Pacific, states either focus on AI technologies research, including UAVs, or import arms and technologies from others. It is still unknown that whether the applications of AI technology will eventually arouse an arm race.

Concerns

The advanced AI technologies that are applied in the military field can exert great impact on deterrence and warfare in the future. Meanwhile, China's rapid development of AI technologies and applications in its military are cause for increasing concern by the United States. Despite the success of China's AI in commercial areas, no clear evidence has indicated that China's military has plans to apply AI in any lethal systems. In the short term, weaknesses still exist despite

China's preexisting foundation on AI commercial applications. Allen points out that China has disadvantages in top talents and technical standards, as well as in software frameworks and platforms.[23] For example, the case of restrictions on ZTE and Huawei clearly reveals that China heavily depends on imports of critical products, which means that China still has a long way to go until it becomes fully independent in vital sectors, such as semiconductors.

AI technology itself is not offensive, but it is likely to play an irreplaceable directorial role in warfare if it is applied to automating weapons, especially nuclear weapons. To avoid unwanted jeopardy to any nations, the top priority is to ensure human intervention is involved in AI that are applied in security-related areas. AI actually lowers the threshold of offensive military actions because of the limited casualty risk. States, including China and the United States, should cooperate on preventing the abuse of AI. According to the China Global Television Network, China is the first nation that has submitted the position paper to the United Nations Convention on Certain Conventional Weapons for regulating the application of AI technologies in military field in December 2021.[24] In other words, as with the control of nuclear weapons, norms and regulations are needed to limit the use of AI armaments.

The United States is concerned about the global proliferation of unmanned systems and other AI weapons since China lacks export restrictions. China's purposes of exporting unmanned arms, such as UAVs, include but are not limited to protecting overseas Chinese and investment security, establishing and consolidating diplomatic relations, and creating commercial profits.[25] The United States is concerned about the unrestricted export for not only security reasons, but also economic ones. To prevent China from occupying the international market of unmanned systems, previous president Donald Trump reinterpreted the Missile Technology Control Regime to boost the export of UAVs. The Biden administration is willing to continue Trump's policy, which made the export more flexible.[26] Therefore, if both superpowers obtain unmanned technologies and export the arms mainly for commercial purpose, it is unnecessary for the United States to raise high concern.

Future

As for the future development of China's AI technology applications in the military area: First, high-altitude long-endurance will be a primary focus of UAV development. Previous UAVs have a small carrying capacity, inadequate power supply, and little endurance, which may result in a small area of reconnaissance, failure to continuously obtain information for a long time, and even "blind spots" in intelligence, thus it is difficult for them to adapt to the needs of future warfare.

Therefore, China's military UAVs must have extensive functions including search and monitoring, air war early warning, and so forth. To this end, new power units such as turbofan engines, rotor engines, solar engines, pulse burst engines, and so forth will be likely to be applied to the future military UAVs.

Second, intelligent control will be developed. At present, China's military UAVs are mainly controlled by programs and the flight routes are relatively fixed, thus it is difficult to cope with various unexpected events on the spot. When the ground control station operates the UAVs, their response usually lags slightly, making it difficult for them to effectively avoid obstacles and dangers. As a result, the intelligence level of military UAVs must be further improved to enhance the UAVs' ability to respond to the situation and their autonomous combat capability.

Third, stealth will be another important direction of UAV development. A large number of composite materials, radar-absorbing materials, and low-noise engines, and so forth will be applied to future military UAVs to further enhance their stealth performance, thus future UAV combat operations can be stealthier, and surprise attacks more viable. Meanwhile, the fuselage surface gap and the radar reflective surface can be reduced.

Fourth, UAVs will be designed to fulfill diversified military tasks. The scope of tasks undertaken by future UAVs will be further expanded, and the task levels will be extended from tactical to battle and strategic levels. The nature of the tasks will also be extended from information support to offensive operations, further achieving the organic combination of reconnaissance and combat. In line with this development trend, diversified aircraft with specific combat functions will appear in China, including unmanned early warning aircraft, unmanned fighter aircraft, unmanned bombers, air combat UAVs, micro-UAVs, and so forth. Hence military UAVs will be widely applied on the future battlefield with a huge battlefield impact and combat power.

Last, UAVs will be operated in concert with manned aircraft. With the continuous development of the world's air-defense weapons, manned aircraft are under increasing threat. If UAVs carry sensors and radar front deployment, serving as the "pathfinder" for manned aircraft, pilot casualties caused by attacks from anticraft weapons can be greatly reduced. Therefore, the integrated application of the two in future will play a mutually reinforcing and complementary role: UAV AI technology will greatly reduce pilots' operational burden while the automatic control, data chain, and navigation technology on manned aircraft mean that the UAVs will no longer be simple remote-control models. UAVs and manned aircraft will each play to their respective advantages, complement each other, and develop together. ✪

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Notes

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