The China AI and Autonomy Report

A biweekly newsletter on AI and autonomy developments in China

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Welcome to the *China AI and Autonomy Report*, a biweekly newsletter published by CNA. Read in underline browser.

This issue of our newsletter has a heavy focus on military news. The *PLA Daily* has run a number of articles on future warfare and cognitive warfare. One article, referencing the Defense Advanced Research Project Agency's "Mosaic Warfare" project, argues that future warfare will be characterized by self-organizing human-machine systems. Another article explains the role of cognitive domain operations in hybrid warfare, arguing that they involve not only military personnel and targets but also civilians and civilian targets. Another article reports that PRC leader Xi Jinping has determined that humans, not machines, are the decisive factor in war. We also feature two articles on unmanned systems: Video of the aircraft carrier *Shandong* shows seven UAVs on its flight deck, and video of a PLA Army exercise shows soldiers working with "robot dogs." In research and development news, the PLA has reportedly developed an AI that can predict hypersonic glide vehicle trajectories. Finally, PRC students took the college entrance examination last week, called the *gaokao*, and Baidu reports that AI is the most searched for college major on its search engine.

THIS WEEK'S CONTENTS

FUTURE WARFARE

***PLA Daily* authors analyze trends in intelligent warfare.** Writing for the *PLA Daily*, the official newspaper of the PLA, three authors [describe](#) how adopting new technologies, such as AI, big data, the Internet of Things, and new computing power, is leading to "intelligent battlefield operations."[1] The authors describe how the "extensive application of AI technology" will expand combat across domains in real time, allow multiple combat units to simultaneously concentrate capabilities, and achieve precise concentration and distribution of capabilities. The report describes how future weapons and equipment will act as intelligent nodes in a battlespace cloud network composed of dispersed modular combat units linked to a disaggregated combat system intended to limit combat system degradation. The authors note that in this system, AI technology will be applied to manned and unmanned combat systems and equipment and ammunition, as well as individual soldier systems, enhancing human-machine coordination and unmanned systems development for intelligent warfare.

The article also details "man-machine" and "human brain-computer" complementarity, describing how human thinking and the high speed of machines can complement each other in future wars. The authors then describe how these dynamics are "profoundly impacting" four trends in combat command, including the following:

1. **Command information acquisition increasingly autonomous.** "Intelligent" information fusion from multiple sources can be processed automatically and delivered to a commander in support of decision-making.

2. **Command decision-making increasingly man-machine coordinated.** Auxiliary decision-making is handed over to AI-enabled decision-making systems to reduce the burden on human commanders, increasing command efficiency.

3. **Command planning is dynamic.** AI-based man-machine intelligent command systems accelerate planning adjustments based on dynamic battlefield information, allowing commanders to update plans and improving rapid actions by combat troops.

4. **Combat equipment and weapons respond autonomously to command and sensor inputs.** AI-enabled weapons and equipment are able to analyze situations independently and make corresponding decisions based on information provided by command information systems and data from sensor technologies.

The authors conclude by noting that AI-enabled unmanned systems in particular are likely to replace humans in certain missions such as highly time-sensitive or dangerous tasks, missions in harsh conditions, and some reconnaissance tasks.

Citing Xi Jinping, *PLA Daily* article discusses humans as "decisive factor" in warfare. An article in the *PLA Daily* titled ["Humans are the Decisive Factor, This Point Will Never Change,"](#) written by an officer in a Shanghai-based unit of the People's Armed Police, calls weapons the important factor in war and humans the decisive factor in war.[2] Quoting Xi, the author writes that "on the issue of winning war, humans are the decisive factor. No matter how conditions develop, and war evolves, this point will never change." The article notes that this finding is based on the PLA's Marxist ideology, and that no matter how unmanned systems may affect future warfare, the operations of these systems will always rely on humans to some degree. As a

result, the article argues that China's armed forces must continue to pay attention to the morale, technical competency, and political indoctrination of its personnel.

COGNITIVE WARFARE

***PLA Daily* authors discuss decentralized operations, "Mosaic Warfare" as trends in future warfare.** An article appearing in the *PLA Daily* titled ["Research the Military, Research War, and Research Combat – Grasp the Changes in Cognition Space in War"](#) argues that one of the characteristics of cognitive warfare is multiple, decentralized actors working toward a common goal.[3] According to the article, emerging technologies such as AI, big data, and data acquisition methods are causing profound changes in warfare that will allow multiple, decentralized actors to work toward a common goal. The article argues that cognitive warfare operations will bypass operations in traditional physical and information domains and will result in achieving victory in the cognitive domain becoming a new "norm of war."

The authors discuss "stigmergy" as a guiding concept of cognitive warfare. Stigmergy was introduced in 1959 by French biologist Pierre-Paul Grasse, who, in [his studies](#) of termites, found that while individual termites worked alone, their collective activities appeared to be coordinated. The concept has since been applied to the command and control of unmanned swarms.[4] The article claims that research has shown that using AI can simulate complex behaviors similar to those of termites and achieve autonomous coordination between weapon systems or combat units. The article states that stigmergy has produced a new form of cognition called "consensus initiative cognition."

According to the article, the interconnection between people, machines, and people and machines will become the norm. Each of these elements will not only communicate with one another at the data and information level but will also share experiences and knowledge at the cognitive level. This connectedness will allow humans and machines to be combined and rearranged to form new links that will overcome the limitations of traditional chain of command structures. Referencing the US Defense Advanced Research Project Agency's "[Mosaic Warfare](#)" project, the article states that the makeup of future combat systems will be flexible, low cost, and capable of autonomous interaction.[5] When a target is discovered, the available forces can automatically adjust to the situation and engage the target, then quickly disband.

PLA Academy of Military Sciences (AMS) researcher discusses role of cognitive domain operations in hybrid warfare. An article in the *PLA Daily* titled ["Cognitive Domain Operations Under the Field of Hybrid Operations,"](#) written by a researcher at the AMS Institute for Military Political Work, discusses the role of cognitive warfare in hybrid warfare.[6] The researcher argues that if the physical domain is the basis for the destruction of enemy forces and the information domain is the means to support a winning advantage in war, then the cognitive domain is the ultimate means of achieving victory.

According to the author, the main weapons of cognitive domain operations are the media, mobile phones, radio and television, and the Internet. The author argues that cognitive warfare can shape combat by affecting an adversary's values, political attitudes, religious beliefs, and spirituality to influence its attitude to a war and lower its morale and will to fight. This can be accomplished through propaganda, cyber attacks, and deep fakes enabled by virtual reality and AI to transmit disinformation. The author argues that "some Western countries" are engaging in cognitive warfare by "instigating color revolutions" and promoting the "peaceful evolution" of other countries in an online "cultural cold war."

The author claims that the role of cognitive warfare operations in hybrid warfare is linked to cognitive

domain operations that no longer involve just military actions but also include attacks against an adversary's financial system, economic blockades, and trade sanctions to deter the adversary and make it yield. In addition, cognitive domain operations can include the involvement not only of military personnel involvement but also that of "government organizations, news media, companies, research institutions, schools and civil society groups, political figures, celebrities, journalists, businessmen, lawyers, actors, scholars, doctors, teachers, and netizens." According to the author, "as long as they can communicate with the outside world," these participants may become a part of the "cognitive domain warfare force." The author also argues, however, that hybrid warfare cognitive domain operations require a large number of trained personnel with professional capabilities in military affairs, communications, psychology, law, journalism, the computer sciences, and other related disciplines.

UNMANNED SYSTEMS

PRC aircraft carrier pictured with drones on flight deck. The PLA Southern Theater Command Navy posted a video to its official WeChat account on May 31 showing J-15 fighter aircraft conducting takeoff and landing drills from the deck of the aircraft carrier *Shandong*. Also pictured in the video are seven vertical takeoff and landing (VTOL) drones parked on the flight deck's starboard side.[7] One report published by *Global Times*, a widely read subsidiary of the *People's Daily* with a strong nationalist bent, quotes an unnamed "expert" describing the fixed-wing VTOL drones in the video as having a relatively short range and limited takeoff weight, but able to conduct transport among ships in a flotilla, or enhance the carrier's situational awareness when used for search or reconnaissance.[8] Speaking on CCTV-7, China's official television station for military affairs, one PLA-affiliated commentator said of the purported drone fleet that "once 'swarming' drones are carrier-borne, the form of naval air combat will see huge changes."[9]

An article published by the US-based website *The War Zone* reports that one drone pictured on the deck may be the PRC-manufactured JOUAV's CW-20, which features a gasoline-powered main engine and electrically powered rotors for VTOL operation.[10] The CW-20, with its nearly 6-foot (1.8 meters) overall length and almost 10.5 foot (3.2 meters) wingspan, has a maximum takeoff weight of just over 55 pounds (25 kilograms). It has a 6-hour endurance, according to the manufacturer, and can operate just under 28 miles (35 kilometers) from the operator using a line-of-sight radio link.

The PLA Navy has been observed flying VTOL drones from ships at least once before, when it flew a derivative of the Sea Cavalry SD-40, manufactured by Xiamen Hanfeiying Aviation Technologies and Xiamen Han's Eagle Aviation Technology, from a Type 052C destroyer in 2019.[11]

Lower caption reads "Once 'swarming' drones are carrier-borne, the form of naval air combat will see huge changes." Source: CCTV-7: *Defense Review Weekly*, June 7, 2022, https://www.js7tv.cn/video/202206_279699.html.

PLA exercises involve robot dogs. CCTV-7, the PRC's official television station for military affairs, reported that a recent amphibious landing exercise held by the PLA Shijiazhuang Campus of the Army Infantry College integrated unmanned and intelligent equipment including "robot dogs," showing "what future amphibious landing warfare could be like."[12] A video purportedly from the exercise shows an unarmed robot dog paired with an unmanned "self-propelled weapon station," as well as accompanying armed troops who appear to be clearing a building.

Source: CCTV-7: *National Defense Morning Report*, June 7, 2022, http://www.js7tv.cn/video/202206_279616.html.

A 2021 *PLA Daily* report described a US-manufactured, armed robot dog called the Special Purpose Unmanned Rifle System that appeared at the 2021 Association of the U.S. Army's annual convention.[13] Although the article did not state whether the PRC was pursuing a similar system, the authors concluded that, "in the near future, more countries may develop weapons and equipment with similar architectures,

and continue to empower them through the use of AI and other technologies for new combat capabilities." On June 8, 2022, a PRC social media account published what the user purported to be a CCTV-7 video clip showing a PLA robot dog armed with a rifle maneuvering around a firing range, shooting at different targets.[14]

Screenshots from purported CCTV-7 video showing an armed PLA robot dog firing at multiple range targets. Source: Wang HanyuW, "The PLA has Used a Robot Dog in the Actual Combat Environment" (我军已经将机器狗运用在实战环境当中), Douyin user 'MengHouRobot' via Headlines Today, June 8, 2022, https://www.toutiao.com/w/1735015888335887/.

RESEARCH & DEVELOPMENT

PLA reportedly develops AI that can predict hypersonic glide vehicle trajectories. According to the _South China Morning Post,_ an article written by a team of researchers from the PLA Air Force Early Warning Academy and published in the PRC peer-reviewed _Journal of Astronautics_ discussed research involving the creation of a model based on AI and machine learning that can effectively predict the trajectory of hypersonic glide vehicles up to speeds of Mach 12.[15] The article, titled "3D Tracking Algorithm of Hypersonic Gliding Target Based on Adaptive Filtering," describes the teams' development of algorithms that produced "high accuracy and stability when tracking near space hypersonic vehicle (NSHV) targets," as demonstrated through simulations.[16]

The ability to predict flight trajectories of hypersonic weapons would be an important development because these weapons, travelling at speeds of Mach 5 or higher, leave little time for an air defense system to respond. The article notes that it is generally believed that existing technology cannot stop a hypersonic glide missile. However, according to the Air Force Early Warning Academy researchers, an air defense system powered by their AI model can estimate the incoming weapon's potential trajectory with low positioning and speed errors (see table below) and initiate a counter response with a three-minute lead time.

Table 1 Statistical average of target position and velocity tracking error

algorithm	Position error/m			Speed error/(m s^{-1})
	Longitudinal ballistics	Lateral ballistics	total error	
IMM filtering of CA+CV+CS	337	353	690	81
literature[10] proposed algorithm	128	167	295	62
This article's motion model + Kalman filter	126	162	288	60
Algorithm	120	81	201	44

Translated table from Air Force Early Warning Academy research paper showing 3D position and speed error in the researchers' hypersonic glide vehicle trajectory prediction model. Source: Zhang Junbiao, Xiong Jiajun, Lan Xuhui, Li Fan, Liu Wenjian, Xi Qiushi, "3D Tracking Algorithm of Hypersonic Gliding Target Based on Adaptive Filtering," *Systems Engineering and Electronic Technology Guidance, Navigation and Control*, 2022, 44(2): 628-636 doi: 10.12305/j.issn.1001-506X.2022.02.33, https://www.sys-ele.com/article/2022/1001-506X/20220233.shtml.

According to the *South China Morning Post*, the PLA Navy reportedly installed a cannon on some newer surface vessels that it said could defeat a hypersonic weapon by firing 10,000 rounds per minute at its predicted course. The purported AI-based hypersonic missile trajectory prediction model may serve to point such a cannon in the right direction.

PRC aviation company files patent for pneumatic drone launcher. The *South China Morning Post* reports that the state-owned AVIC Chengdu Aircraft Industrial Group has filed a patent application for a UAV launcher system that uses air pressure to catapult drones into the air.[17] The system is said to be superior to the use of booster rockets because it will not emit light, sound, or exhaust that could reveal the position of the launch system to an enemy.

LOCAL POLICY

Beijing government COVID-19 economic growth plan highlights AI research, investment, and applications. On June 2, the Beijing municipal government published its "Implementation Plan for Coordinated Epidemic Prevention and Control and Stabilizing Economic Growth in Beijing," outlining how the city would support residents and companies in "implementing the requirements of the CPC central committee to carry out epidemic prevention, stabilize the economy, and develop safely."[18] The plan invokes AI in two areas.

1. **Smart cities.** The plan is intended to guide the development of "smart cities," including by accelerating AI research and development through "in-depth cooperation between enterprises and national laboratories, national key laboratories, R&D institutions, and colleges and universities." The plan suggests that breakthroughs in AI resulting from this plan will support new digital economic models—such as digital retail, social e-commerce, online fitness, online diagnosis and treatment—and expand the "Internet+" plan initiated in 2015 to promote e-commerce.

2. **Zhongguancun Jingxi Artificial Intelligence Innovation Center.** The plan states one objective as "accelerating the construction" and "promoting the completion of a number of major projects" such as

the [Zhongguancun Jingxi Artificial Intelligence Innovation Center](#), a partially occupied AI development park. According to the park's website, the AI innovation center will serve as "an innovative community with AI characteristics… and achieve an annual output value for the regional AI industry of 20 billion RMB." The park's website currently lists 14 occupant entities, with space for 200.[19]

Of note, the plan states that the Beijing government will "support the listing of local enterprises in Hong Kong and promote the listing of qualified enterprises overseas in accordance with laws and regulations." This announcement follows a May 17 meeting of the Chinese People's Political Consultative Conference in which Vice Premier and Politburo member Liu He stated that the government needed to increase direct investment in the digital economy and support the listing of digital companies in the capital markets at home and abroad (see [Newsletter 16](#)). This remark appeared to be a departure from 2021 guidance by CCP Party Chairman Xi and China Securities Regulatory Commission regulations that sought to crack down on overseas listings by mainland companies.

HIGHER EDUCATION

AI is China's most popular university major for third year in a row, according to Baidu search data. According to [data](#) published by PRC tech giant Baidu and reported by state-run media, for the third year running, AI topped the list of the 10 most-searched majors among students preparing to take the 2022 PRC college entrance exam, known as the *gaokao*.[20] The next most popular majors, according to the search data, are mechanical engineering, electrical engineering and automation, and big data technology. This marks a shift from previous years where, from 2013–2016, majors such as financial management, international economics, and other majors related directly to financial business and trade were the most popular, according to a PRC-based [AI industry blog](#).[21] This blog notes 7 PRC universities with "strengths" in their AI academic programs; they are Tsinghua University, Peking University, University of Electronic Science and Technology of China, Xidian University, Zhejiang University, Shanghai Jiaotong University, and Harbin Institute of Technology. Of note, some PRC "netizens" reportedly believe that "AI fever" has led some colleges and universities to set up AI majors "overnight," even though they lack the understanding or resources to train students properly in AI.

NOTES

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[9] CCTV-7: *Defense Review Weekly*, June 7, 2022, https://www.js7tv.cn/video/202206_279699.html.

[10] Joseph Trevithick, "Chinese Aircraft Carrier Seen With a Fleet of Drones on Its Deck," *The War Zone*, June 2, 2022, https://www.thedrive.com/the-war-zone/chinese-aircraft-carrier-seen-with-fleet-of-drones-onboard.

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[12] CCTV-7: *National Defense Morning Report*, June 7, 2022, http://www.js7tv.cn/video/202206_279616.html.

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