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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 browser.

PRC media has presented a thoroughly sanitized version of the war in Ukraine that blames the US for the conflict and avoids depicting Russia in an unflattering light, while largely refraining from deeper analysis of Russian and Ukrainian military performance, including the use of AI and autonomy in the war. However, we continue to follow allegations that DJI has altered its UAV technology to give Russia an edge in the conflict. As a result of the allegations, last week German electronics retailer MediaMarkt removed all DJI products from its shelves. Meanwhile, the *PLA Daily* has published articles pondering the role of humans in future warfare, with one author from the PLA Naval Research Academy envisioning that humans will continue to play a fundamental role even as autonomous systems become more advanced and ubiquitous. We also report that the PRC has published new ethical guidance that articulates five overarching principles for science and technology research. PRC researchers have been using AI to develop engines for hypersonic missiles and planes and to enhance skid landing systems. PRC researchers have also been involved in projects involving brain-computer interfaces, including using AI to improve technology that allows a machine to be directed by a human's brain to control a robotic arm—an experiment that reportedly has the potential to transform how astronauts operate the giant arm on the Chinese space station.

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# PRC DRONES AND THE RUSSIA-UKRAINE WAR

**DJI continues to deny accusations that it altered its UAV technology to give Russia a military advantage in Ukraine.**[1] Pressure has mounted on leading global drone-maker DJI since the beginning of March, when it first faced allegations on Twitter that it was altering its UAV AeroScope technology to aid the Russian military offensive in Ukraine.[2] Following these initial allegations, Ukraine's minister of digital transformation, Mykhailo Fedorov, sent a letter on March 16 to DJI founder and CEO, Frank Wang, requesting that DJI provide the Ukrainian government information about its products in Ukraine, and asked the company to "block all DJI products which were purchased and activated in the Russian Federation, Syria and Lebanon."[3] On March 17, DJI replied to Fedorov in a Tweet stating, "All DJI products are designed for civilian use and do not meet military specifications."[4] The DJI response further noted that its AeroScope technology is not appropriate for "military missions," and "DJI has not changed the functionality of our AeroScope system in any way in Ukraine."

Less than two weeks later, on March 28, German electronics retail giant MediaMarkt removed DJI UAVs from its stores, citing concerns that the Russian military was using "products and data" from DJI.[5] DJI responded in a statement that the allegations are "utterly untrue" and that it does "not support any use of our products that harms people's lives, rights, or interests, as we have always reiterated in our products' Terms of Use and other public statements. We do not provide technical support when military use of our products is identified." DJI also reiterated that all of its products "are designed for civilian use," and that it "complies with applicable laws and regulations worldwide."[6]

# FUTURE WARFARE

**PLA Navy researcher argues that humans will maintain an essential role in unmanned operations.** In a *PLA Daily* article titled "Pay Attention to the Role of Humans in Unmanned Operations," a researcher from the PLA Naval Research Academy discusses the role of humans in future warfare and argues that humans will still play an integral role in unmanned operations through the stages of technology development, operational planning, and execution.[7]

The author asserts that, despite the advantages of unmanned systems, humans will continue to play a fundamental role in their operation, regardless of the ubiquity and level of autonomy of these systems. The author writes that unmanned systems are suited for high-threat environments, have the ability to conduct persistent operations, can be low cost, and can operate in extreme environments. Humans, however, will still be responsible for mission planning and will decide when and how unmanned systems will be used. Because of the current limitations of autonomous capabilities, during operations humans will be required to redirect or reassign unmanned systems to respond to rapidly changing battlefield conditions.

The author also argues that humans must constrain autonomous unmanned systems through the development of algorithms that govern their operation in ways that conform to the laws of warfare. As a result, humans must have the ability to monitor the performance of unmanned systems and be allowed to intervene in their operation. At the conclusion of a mission, humans will also need to evaluate mission effectiveness in order to adjust subsequent operations accordingly. The author proposes that PLA personnel operating unmanned systems be incentivized to remain in the PLA and complete a unified, multi-step training program involving, in part, additional courses on AI conducted by specialized institutions.

**A *PLA Daily* article asserts that technological advances will drive the move toward a "human-on-the-loop" approach to unmanned systems.** A *PLA Daily* article titled "Human-on-the-Loop: The Development Trend of Intelligentized Command Systems" explores the role of humans in future warfare, arguing that the trend of technology development will drive militaries to take a "human-on-the-loop" approach to the command and control (C2) of autonomous weapons.[8]

The article describes a "human-in-the-loop" approach as an intermediate stage of C2 for autonomous systems characterized by extensive human-machine interaction and computers taking over some of the command and decision-making tasks normally performed by humans. As AI technologies advance, however, computers will be able to take on more C2 responsibilities with greater reliability, such that humans will become more trusting of machines to make sound decisions. This will result in militaries taking a "human-on-the-loop" approach to autonomous systems that relieves humans from the direct control of autonomous systems but allows commanders the option to intervene if the operation requires changes in direction, targets, or speed.

Regardless of whether militaries take a "human-in-the-loop" or "human-on-the-loop" approach to the C2 of autonomous systems, the authors argue that command decision-making systems will need to present information to operators in ways that are easily accessible and understandable by humans. For example, as AI systems become more advanced, the interface between humans and machines will need to become multimodal and move from two-dimensional displays to three-dimensional displays and virtual reality. In addition, a transition from typed commands to voice commands and brain-machine interfaces will be required.

**PLA researchers discuss factors driving informatized warfare.** In an article on *China Military Online,* the PLA's official news and information portal, three researchers from PLA unit 61001 use the human body as a metaphor to argue that advances in networks, data, cloud computing, the electromagnetic spectrum, and algorithms will drive the direction of future warfare.[9]

***Networks.*** Networks are the "skeleton" of modern combat systems. The authors argue that the key to improving combat capabilities is promoting the interoperability of combat forces at all levels and improving the sensor-to-shooter chain through an integrated system of networks.

***Data.*** Data is the "blood" of combat systems. The authors argue that good planning requires data, and that the more data available to a commander, the better the planning will be. With the integration of big data, cloud computing, and AI, large amounts of data can be gathered, processed, and analyzed, resulting in quicker and more accurate decisions and the ability to reveal opportunities that were previously hidden.

***Cloud computing.*** Cloud computing is the "nerves" of combat systems. The authors argue that cloud computing, with its powerful computing capabilities and large amounts of data, can be used to achieve the rapid integration of battlefield intelligence, real-time battlefield situational awareness, and real-time threat assessments and can provide situational awareness of enemy and friendly force dispositions.

***Electromagnetic spectrum*.** The electromagnetic spectrum enables the "eyes and ears" of modern warfare. The authors assert that maintaining the advantages of the electromagnetic spectrum is an important prerequisite for seizing "tactical, operational, and strategic advantages." They also assert that using reconnaissance methods to control the electromagnetic activities on the battlefield, judge enemy combat intentions, predict the operational situation on the battlefield, determine combat targets, decide on the direction of combat, rationally deploy troops and weapons, and scientifically plan "information firepower" have become the focus of battlefield perception and the forces empowering combat command.

***Algorithms.*** Algorithms are the "brain" of combat systems. Citing alleged human-machine experiments of the US military, the authors argue that AI has created a new phase of algorithm-led cognition and decision-making that will empower commanders with average IQs to have the genius possessed by history's greatest

commanders. Conversely, the power of algorithms will also increase the importance of cyber warfare as militaries seek to undermine an opponent's algorithms. According to the authors, "If we want to seize the high ground of cognitive competition, we must increase the development of algorithmic warfare research, and turn our own advantages in data, information, intelligence, and algorithms into intelligentized advantages, combat power advantages, and winning advantages."

# UNMANNED SYSTEMS

**A UAV for civilian and military use demonstrates extended endurance during its first flight with a hydrogen-powered battery.** On March 13, the AR-20, a "multi-rotor drone domestically developed by China for security surveillance, border patrol, and anti-terrorism missions," took its first test flight with a hydrogen-powered battery.[10] The drone was developed by the China Helicopter Research and Development Institute (CHRDI), a subsidiary of major PRC military contractor Aviation Industry Corporation of China (AVIC). During a hovering test, the hydrogen-battery version of the AR-20 displayed an "endurance of three hours and 12 minutes," which is reportedly an improvement of more than an hour compared to the UAV version with the lithium battery. A statement from CHRDI noted that the endurance enabled by the hydrogen-powered battery was significant for expanding the use of the AR-20 in both military and civilian fields.[11] A Beijing-based military expert told the *Global Times* that the AR-20's longer endurance is "particularly meaningful in scenarios like patrol missions along high-altitude border regions, where the complex terrains and the lack of oxygen make it difficult for humans to carry out patrols on a regular basis." Recently, there has been a notable interest in hydrogen-powered batteries for UAVs in China—our last newsletter (available here) described how the Chongqing Research Institute used hydrogen-powered batteries in a fixed-wing, vertical take-off and landing drone to increase its endurance to nine hours.

# NEW ETHICS GUIDELINES

**PRC releases new ethical guidelines for science and technology (S&T).** On March 21, the General Office of China's Communist Party and the General Office of the State Council published "Opinions on Strengthening the Ethical Governance of Science and Technology" (hereon referred to as "Opinions").[12] The "Opinions" outlines broad ethical principles for S&T, seeks to consolidate and strengthen oversight of an ethical governance system for S&T at national and local levels, and aims to strengthen education and publicity about ethics in S&T. At the national level, the document highlights the role of the PRC's National Science and Technology Ethics Committee (NSTEC), which was established in 2020, in guiding, coordinating, and promoting the PRC's S&T ethical governance system.[13] Officials from the Ministry of Science and Technology (MOST), which manages the day-to-day work of NSTEC, held a press conference upon the release of the document.[14] Notable aspects of the document include the following:

***Five ethical principles:*** The ethical principles established for S&T by the "Opinions" are: 1) enhancing human welfare; 2) respecting the rights of the lives of humans and animals; 3) adhering to fairness and justice; 4) reasonably controlling risks; and 5) maintaining openness and transparency. During the press conference held upon the release of the "Opinions," a MOST official remarked that the principles chosen were based upon consensus from relevant parties and also from "learning from the experience of the international community."

***AI in the new guidelines:*** AI, along with life sciences and medicine, is called out explicitly in the document. *The South China Morning Post* suggests that the new guidelines have emerged in part because of backlash experienced by Beijing due to controversies in these fields, such as the gene-edited baby scandal and the use of AI for social scoring and mass surveillance purposes.[15] The "Opinions" state that entities engaging in

projects in these fields, and whose research content involves "sensitive areas" for S&T ethics, shall "establish scientific and technological ethics review committees." The document further asserts that during the 14th five-year plan period (2021–2025), research on ethics legislation for fields such as life sciences, medicine, and AI should be strengthened, and that important ethical norms should be elevated into national law and regulations in a timely fashion.

***International research and ethics standards engagement:*** The "Opinions" also contain language that discusses PRC S&T research ethics internationally. It supports the efforts of entities such as organizations, think tanks, social groups, and scientists to "actively promote and participate in discussions on major international science and technology ethics issues and rule-making." It also advocates for ethical review and supervision of international collaborative research activities to ensure that they comply with the ethical requirements of all countries involved in the research. For international activities that present high ethical risks, the document suggests that local and relevant industry authorities organize experts to evaluate the results of scientific and technological ethics reviews.

# R&D ON AI AND HYPERSONIC TECHNOLOGY

**PRC military researchers have reportedly made progress toward building an AI system that can design new hypersonic systems.** A research team from China Aerodynamics Research and Development Centre (CARDC) has published research findings in the PRC's *Journal of Propulsion Technology* on how AI could improve the performance of hypersonic technology.[16] According to the Australian Strategic Policy Institute (ASPI), the Sichuan-based CARDC is a military unit that is "heavily involved in research on hypersonics" and hosts a key state laboratory with a large computing cluster and wind tunnels.[17] CARDC researchers report that the machine used in their study could identify most of the shock waves occurring in wind tunnel tests, even though the machine did not receive instructions on what to look for.[18] The AI was also able to build a knowledge base without human intervention to aid the development of new engines for hypersonic missiles and planes that could travel longer distances at faster speeds. Le Jialing, head of the CARDC research team and long-time hypersonic weapons advisor to the PLA, stated that one challenge researchers have faced is "provid[ing] a large amount of training [data] for deep learning models" because of the complexity of the aerodynamics at hypersonic speed. To address this issue, the team used a technique known as "unsupervised segmentation" to "establish a relationship between seemingly unrelated objects." The *South China Morning Post* suggests that this research is relevant to China's plans to extend hypersonic flight technology from military to civilian sectors, with an official goal by 2035 to build a hypersonic plane that can carry passengers anywhere in the world in a couple of hours.

**PRC researchers are investigating whether AI and machine learning algorithms could improve the accuracy of hypersonic aircraft skid landing systems.** According to the *South China Morning Post,* Nanjing University of Aeronautics and Astronautics (NUAA) is researching how to use AI for alternative landing systems for hypersonic aircraft.[19] The NUAA research team is exploring the feasibility of landing technology that would use a skid landing system rather than wheels—a design that was abandoned by NASA in the 1960s over concerns that the inability of the skids to break or steer would endanger pilots. The NUAA research team believes "machine learning algorithms [could] identify the best ways to land so the skid landing gear control system can keep the plane on course in any conditions by exchanging information based on data collected by sensors." Even if the AI and machine learning algorithms are better able to control the skid landing system, lead researcher Wei Xiaohui noted that the plane would still require "a concrete air strip" for safe landings.

# R&D ON BRAIN-COMPUTER INTERFACES

**A joint US-China research team has made an important contribution to brain-computer interface technology with the development of a new type of flexible electrode.** On March 24, a research team from Stanford University, Beijing-based Capital Medical University, Tianjin University, Nanjing University, and Beijing-based BOE Technology Group published in the journal *Science* their approach to developing a new type of flexible electrode and its resulting enhanced conductivity.[20] *Science & Technology (S&T) Daily,* the leading official PRC newspaper for S&T issues, reported that the new type of flexible electrode is placed on the brain during a craniotomy, enabling the physician to distinguish between nerve nuclei and cerebral cortex functionality, thus maximizing the protection of brain function during surgery and reducing the possibility of surgical disability and death.[21] *S&T Daily* further reports that this new type of flexible electrode has the highest precision in the world and will serve as a core technology for brain-computer interfaces, playing a potentially important role in the future of brain science research and clinical translation.

**PRC space program researchers develop brain interface to control robotic arm.** The *South China Morning Post* reports that researchers with the PRC's human spaceflight program have developed a technology to enable people to control a robotic arm using their brainwaves.[22] The research conducted at the China Astronauts Research and Training Centre requires a person wearing a head-mounted device "to look at an animated robotic arm on a computer screen." Each part of the robotic arm then "blinks at a unique rate, and when the eyes focus on a blinking component, it stimulates the formation of brainwaves with the same frequency," allowing the machine to "read the mind." Though in this type of research, useful signals from the mind tend to be rare and weak, the research team used AI to improve the process. According to the report, the robotic arm responded almost instantaneously to commands by the human brainwaves with significantly higher accuracy than previous studies displayed. According to the article, the development is important because it could "transform how astronauts operate the giant arm on the Chinese space station." Additional details of the study are classified, and it is unclear when the technology could be made operational.

# NOTES

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