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

In this issue, a *PLA Daily* article discusses using unmanned systems and AI to aid surprise attacks in deep-sea warfare. The PRC's first 100+ ton unmanned surface vessel has conducted its first autonomous sea trial. PRC researchers have reportedly developed an AI model for use in space warfare, while engineers at the Aviation Industry Corporation of China have developed an unmanned cargo plane that adheres to Chinese Civil Aviation Regulations. The *South China Morning Post* reports that the PRC has developed an exascale supercomputing capability nearly on par with that of the US. The PRC has fully approved the "East Data, West Computing" plan, which has established 10 computing centers, although obstacles to its success remain.

THIS WEEK'S CONTENTS

FUTURE WARFARE

DEEP-SEA WARFARE

A *PLA Daily* article discusses the use of unmanned deep-sea systems in surprise attacks. The *PLA Daily*, the official newspaper of the PLA, published an article titled "Achieving Victory in the Deep Sea, the Need to Scientifically Understand and Grasp the Combat Value of Deep-Sea Space," which discusses the importance of unmanned systems and AI in deep-sea operations.[1] According to the article, the deep sea is the "new high ground to seize the initiative in war" because of its special natural environment and important strategic position.

The article reports that operations in the deep sea are an emerging operational type that is becoming more important with the development of deep-sea technologies, sensor technologies, communication technologies, and AI. According to the article, "new platforms and weapons such as unmanned submersibles, undersea prepositioned weapons, and foreign military bases will bring about the reconfiguration of maritime combat systems." The article concludes that deep-sea operations will lead to new tactics being conducted from the deep-sea domain, including ambushes, mobile breakthroughs, long-range assaults, cross-domain attacks, and close-in interceptions.

In fact, the ability to conduct surprise attacks will become a paramount feature of deep-sea operations through an integrated combination of unmanned systems, sensor networks, and communications links. The article states that deep-sea pre-positioned weapons systems can be pre-deployed in key sea areas and waterways well in advance of an operation and activated remotely to conduct surprise attacks. Deep-sea operations, conducted primarily in the open ocean, will be facilitated by the lack of political borders and the ability to deploy systems over a wide area and in different configurations, and will be assisted by the difficulty in detecting deep-sea submersibles because of their submerged depth and ocean hydrology.

Deep-sea operations will be supported by intelligent network information systems that are highly integrated and adaptable to the timing and place of the operations as well as to enemy action. Deep-sea systems integrate the ability to conduct situational awareness, rapid mobility, persistent loitering, concealment, and precision strikes with low defense requirements and low cost. As a result, deep-sea systems can achieve technology surprise that can defeat adversary systems.

HUMAN-MACHINE TEAMING

A *PLA Daily* article discusses the evolution of manned and unmanned systems. The *PLA Daily* published an article titled "A New Fulcrum to Leverage the Form of War," which discusses the role of human-machine teaming in future wars.[2] According to the article, "manned/unmanned collaborative operations have rewritten the modern battlefield model," and the use of a large number of autonomous unmanned systems will "reshape the combat force system" leading to new configurations and opportunities to leverage synergies between manned and unmanned systems.

The article argues that as technology advances, flexible human-machine and machine-machine configurations will become more prevalent. Using the "loyal wingman" concept as an example, the article

concludes that using new manned/unmanned combat modes will become an effective way to maintain air superiority and that these modes represent a trend in the evolution of modern air warfare.

The article states that with the use of cloud systems, data from weapon systems and sensors in multiple domains can be fused and verified under a unified framework leading to interoperability between manned and unmanned systems through greater real-time sharing of data and a common operating picture.

Manned and unmanned systems operating within this framework will be characterized by distributed command systems operating over a wider area than current operations do. The rise of distributed command systems will also lead to the prominence of unmanned swarm technologies because of their low cost and operational flexibility. In swarm operations, individual systems will be able to carry out mission planning and operations independently with the loss of any one platform or system not affecting the performance of the system as a whole.

RESEARCH AND DEVELOPMENT

PRC's first 100+ ton unmanned vessel conducts initial autonomous sea trial. On June 7, China conducted the first autonomous sea trial for the mainland's largest unmanned vessel, according to CCTV-7, China's official television station for military affairs.[3] The CCTV-7 report stated that the successful autonomous navigation test in the waters off Zhoushan, Zhejiang province represented a "breakthrough in China's unmanned and autonomous ship navigation [capabilities] and 'smart cabin' technology." PRC media sources reported that the 40-meter-long trimaran vessel has a 200-ton displacement, a maximum sailing speed of more than 20 knots, the ability to operate normally in sea state 5 conditions (defined as "rough," with 2.5-to-4-meter waves), and the ability to navigate safely in sea state 6 conditions (defined as "very rough," with 4-to-6-meter waves).[4] PRC media sources did not ascribe a name or hull number to the vessel. The initial sea trial contained two navigation routes that, in total, collected data for three hours. The next sea trial reportedly will focus on "collision avoidance."[5]

Screenshot from CCTV-7 video showing the unnamed vessel conducting its first autonomous sea trial near Panzhi Island, Dinghai, Zhoushan City, Zhejiang province. Source: CCTV-7: *National Defense Morning Report*, June 9, 2022, https://tv.cctv.com/2022/06/09/VIDEIgBoVIaSI6uRDVVzYI5O220609.shtml?spm=C52346.PQw42etIf8YI.Edvk0IT63y7P.10.

According to a report published by Shanghai-based *Xinmin Evening News*, the Zhejiang Beikun Intelligent Technology Co., Ltd., along with 40 other entities, was involved in the development and testing of the vessel, which began in 2015. The *Xinmin* report stated that the goal of the project was to "achieve unmanned and autonomous design of a 100-ton vessel that can achieve high-seas navigation with low noise and high stealth." Key technological hurdles surmounted to achieve the first autonomous sea trial, according to the report, include "variable speed low-voltage hybrid integrated power technology, integrated sensing and mast technology, and autonomous navigation control technology." Prior to the June 2022 sea trial, the vessel reportedly conducted roughly 30 test voyages totaling more than 1,000 nautical miles on Poyang Lake, Jiangxi province. Of note, while the head of Zhejiang Beikun Intelligent Technology Co., Ltd., Ma Haifung, stated that the first autonomous sea trial was a success and showed that the vessel had "entered the stage of artificial intelligence empowerment… and we are sailing autonomously in relatively open seas," he cautioned that "there is still a long way to go to meet the requirements of high-speed autonomous navigation."[6]

PRC researchers develop AI system to simulate space warfare. According to the *South China Morning Post*, an article written by a team of researchers from the Shanghai Institute of Aerospace System Engineering and published in the PRC peer-reviewed journal *Aerospace Shanghai* on April 25 discussed research involving the creation of an AI system used in space warfare simulations.[7] The simulation involved three satellites attempting to capture a high-value satellite. Both sides performed poorly in the first 10,000 rounds of training, but the offensive team of three satellites was able to learn faster than the high-value satellite and secured an advantageous position after 20,000 rounds. After experiencing repeated defeats, the high-value satellite learned to develop countermeasures to defeat the three satellites. Despite this achievement, after running 220,000 rounds, the offensive satellites began to again seize the advantage, leaving the high-value satellite with "no room for mistakes."

PRC conducts flight of large cargo UAV. According to PRC state media, the Aviation Industry Corporation of China (AVIC), a state-owned defense conglomerate, completed a successful 27-minute maiden flight of the TP500 unmanned cargo aircraft on June 18 in the central province of Hubei.[8] According to AVIC, the TP500 is manufactured by AVIC's First Aircraft Institute and is China's first large, unmanned freighter produced under the PRC's Chinese Civil Aviation Regulations. The aircraft has a maximum range of 1,800 km and can carry 500 kg payloads for a range of 500 km.

According to the Aviation Week Intelligence Network, the flight of the TP500 is not the first unmanned cargo aircraft flown by PRC entities. In 2018, the Chinese Academy of Aerospace Electronics Technology flew the unmanned FH-98, derived from the Y-5, a utility bi-plane first built in 1957. In 2017, the Chinese Academy of Sciences flew the unmanned AT200, derived from the New Zealand-built Pacific Aerospace P750XL. Both aircraft could transport payloads up to 1,500 kg.[9]

The TP500 on a taxiway. Source: Liu Xun, "China's First Large CCAR TP500 Unmanned Freighter Makes Maiden Flight," CGTN, June 20, 2022, https://news.cgtn.com/news/2022-06-19/China-s-first-large-CCAR-TP500-unmanned-freighter-makes-maiden-flight-1aZb6TNa0FO/index.html.

PRC reportedly develops new exascale supercomputer on par with the US Frontier. The *South China Morning Post* published an article titled "China Supercomputer Achieves Global First With 'Brain-Scale' AI Model," which reports that the PRC has developed a supercomputer on par with the world's first exascale supercomputer, Frontier, which was developed by the US Department of Energy. Frontier was ranked as the world's fastest supercomputer in May with an overall performance of 1.1 exaflops of performance (an exaflop is a measure of supercomputer performance equal to 10^{18} operations per second).[10] The PRC supercomputer, named the New Generation Sunway Supercomputer, appears to be part of the family of Sunway supercomputers and is a follow-on to the Taihu Light Supercomputer based at the National Supercomputing Center in Wuxi, Jiangsu province. The intent to build an exascale follow-on to the Taihu Light is not a complete surprise and was reported by the website The Next Platform in February 2021.[11]

The use of the new supercomputer was discussed in a paper titled "BAGUALU: Targeting Brain Scale Pretrained Models With Over 37 Million Cores," which was presented at a virtual meeting of Principles and Practice of Parallel Programming 2022, an international conference hosted by the US-based Association for Computing Machinery in April and posted online here.[12] The paper was written by a team of 14 professors, students, and researchers from Tsinghua University, Zhejiang Lab, and the e-commerce giant Alibaba. According to the article, the supercomputer has a performance of 1.002 exaflops, slightly less than the Frontier supercomputer. The New Generation Sunway Supercomputer was used to run an AI model named BAGUALU, which has the capability to train 174-trillion parameter models—a number that, according to the article, "rivals the number of synapses in a human brain." Of note, other research has claimed that the human brain is thought to contain even more synapses, including one estimate of 600 trillion synapses.[13]

NATIONAL POLICY

PRC officially launches "East Data, West Computing" project. The *People's Daily*, the official newspaper of the Chinese Communist Party, reports that the PRC central government has officially launched the "East Data, West Computing" project.[14] In February this year, the PRC government approved the construction of 10 regional computing power hubs in Beijing, Tianjin and Hebei, the Yangtze River Delta, Guangdong, Hong

Kong and the Macao Bay Area, Chengdu and Chongqing, Inner Mongolia, Guizhou, Gansu, and Ningxia. As discussed in Newsletter 10, the project aims to store and process data from the eastern regions of China in computer centers in China's western regions. According to the PRC government, eastern China, where the majority of data centers are located, has limited land, energy, and resources, making it "unsustainable" for the development of big data centers. Western China, however, offers abundant resources, especially renewable energy, and "has the potential to develop data centers to meet the computing power demand of the eastern region." Annual investment in the project is around 400 billion yuan.

According to the article, in 2021, China had 5.2 million data center racks, with PRC companies having a 74 percent share of the server market. The average annual growth rate of China's data center racks has exceeded 30 percent over the past five years and is expected to have an annual growth rate of 20 percent during the 14th Five-year Plan covering 2021–2025. At the same time, the total energy consumption of China's data centers in 2020 was 93.9 billion kilowatt hours, with carbon emissions of 64.64 million tons. The total energy consumption of China's computing centers is expected to reach about 380 billion kWh by 2030. If renewable energy sources are not used, the total carbon emissions produced by China's computing centers will exceed 200 million tons and will account for around 2 percent of the country's total carbon emissions.

According to experts cited by the article, even though one goal of the project is to encourage high-tech economic development in the PRC's relatively less-developed western region, the project is limited by deficiencies in bandwidth, human capital, market environment, and a shortage of applications. According to Wu Hequan, an academician at the Chinese Academy of Engineering, the computing centers are likely unsustainable without government support, such as subsidies for electricity and land concessions.

Notes

[1] Liu Lijiao and Zhang Buwei, "Achieving Victory in the Deep Sea, the Need to Scientifically Understand and Grasp the Combat Value of Deep Sea Space," (制胜深海，需要科学认识和把握深海空间的作战价值), *PLA Daily*, June 14, 2022, http://www.81.cn/yw/2022-06/14/content_10162841.htm.

[2] Guo Yilun and Ma Quan, "A New Fulcrum to Leverage the Form of War" (撬动战争形态衍变的新支点), *PLA Daily*, June 21, 2022, http://www.81.cn/bz/2022-06/21/content_10165050.htm.

[3] CCTV-7: *National Defense Morning Report*, June 9, 2022, https://tv.cctv.com/2022/06/09/VIDEIgBoVlaSl6uRDVVzYI5O220609.shtml?spm=C52346.PQw42etIf8YI.Edvk0IT63y7P.10; One report published by China Economic Daily (每日经济) stated that this vessel "is the largest unmanned vessel in China, and only the United States has unmanned ships of more than 100 tons." See "China's First Domestically Produced 100-ton Unmanned Vessel Completes its First Sea Trial" (中国首艘全国产化百吨级无人艇完成首次海上试航), *China Economic Daily*, June 9, 2022, https://cn.dailyeconomic.com/tech/2022/06/09/22673.html.

[4] "China's First 100-ton Unmanned Vessel Completed its First Maritime Autonomous Navigation Test in Zhoushan" (我国首艘百吨级无人艇在舟山完成首次海上自主航行试验), *Xinmin Evening News*, June 9, 2022, http://wap.xinmin.cn/content/32181231.html; CCTV-7: *National Defense Morning Report*, June 9, 2022, https://tv.cctv.com/2022/06/09/VIDEIgBoVlaSl6uRDVVzYI5O220609.shtml?spm=C52346.PQw42etIf8YI.Edvk0IT63y7P.10; "World Meteorological Organization (WMO) Sea State Code," University Corporation for Atmospheric Research, Accessed June 10, 2022, http://dss.ucar.edu/datasets/ds464.0/docs/WMOtables.html.

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[6] "China's First 100-ton Unmanned Vessel Completed its First Maritime Autonomous Navigation Test in Zhoushan" (我国首艘百吨级无人艇在舟山完成首次海上自主航行试验), *Xinmin Evening News*, June 9, 2022, http://wap.xinmin.cn/content/32181231.html.

[7] Stephen Chen, "China Develops AI That 'Can Use Deception To Hunt Satellites,'" *South China Morning Post*, June 13, 2022, https://www.scmp.com/news/china/science/article/3181546/china-develops-ai-can-use-deception-hunt-satellites.

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[10] Zhang Tong, "China Supercomputer Achieves Global First With 'Brain-Scale' AI Model," *South China Morning Post,* June 22, 2022, https://www.scmp.com/news/china/science/article/3182498/china-supercomputer-achieves-global-first-brain-scale-ai-model and "Frontier Supercomputer Debuts as World's Fastest, Breaking Exascale Barrier," Oak Ridge National Laboratory, May 30, 2022, https://www.ornl.gov/news/frontier-supercomputer-debuts-worlds-fastest-breaking-exascale-barrier.

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[12] Zixuan Ma, et al., "BAGUALU: Targeting Brain Scale Pretrained Models With Over 37 Million Cores" https://pacman.cs.tsinghua.edu.cn/~zjd/publication/ppopp22-bagualu/ppopp22-bagualu.pdf.

[13] See, for example, Mark Wanner, "600 Trillion Synapses and Alzheimers Disease," The Jackson Laboratory, Dec. 11, 2018, https://www.jax.org/news-and-insights/jax-blog/2018/december/600-trillion-synapses-and-alzheimers-disease.

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