

## 附件 2-1 E-NOVATE 2026 波兰国际创新展览会线上展

### 发明项目展板英文图片内容(一)

CAI No. 04-1

**Invention:** Agent-Driven Virtual-Real Integrated Testing System for Ship Shore-Based Remote Control                      智能体驱动的船舶岸基驾控虚实融合测试系统

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**Patent No.:**

ZL202411823745.8; ZL2019 1 0447085.0; ZL202010702462.3; CN202211324545.9

**Introduction :**

Driven by urgent needs in ship shore-based remote control for key technology validation, complex scenario testing, and full-process safety evaluation, this project has developed an agent-driven virtual-real integrated testing system for ship shore-based remote control. With a multimodal large language model as its intelligent core, the system is centered on the full process of perception, cognition, decision-making, control, takeover, and evaluation. It establishes a virtual-real integrated testing framework covering the shore side, ship side, cloud side, and communication links, and forms a new validation pathway featuring autonomous learning, intelligent decision-making, and continuous evolution.

The project has achieved several major innovations. It proposes an agent-driven closed-loop test orchestration mechanism, which supports semantic parsing, task decomposition, scenario orchestration, workflow planning, and tool invocation in response to testing requirements, while integrating short-term and long-term memory to enable knowledge accumulation, continual learning, and capability evolution. It constructs a digital twin-driven virtual-real integrated closed-loop testing architecture, enabling full-chain collaborative validation for ship shore-based remote control and supporting full-process testing through multiple modes such as HIL, HITL, and SITL. It establishes a data-and-knowledge-fused, LLM-driven test scenario generation mechanism, which automatically converts natural-language testing requirements into structured scenario scripts and builds a broad-coverage scenario library by integrating real-world data with expert knowledge. It also proposes a digital twin-enabled disturbance injection and quantitative evaluation mechanism, achieving equivalent disturbance injection into the physical vessel and control chain and enhancing testing and validation capability under complex environments and abnormal operating conditions.

The project has developed a relatively complete system and platform framework, and its related achievements have already been applied in scenarios such as intelligent ship navigation and shore-based remote control testing. The project can significantly reduce the proportion of high-risk sea trials, shorten research and development cycles, and improve system iteration efficiency and verification accuracy. At present, these achievements have been adopted by multiple enterprises, including CETC, strongly supporting the upgrading of intelligent shipping equipment and the development of related products, and generating cumulative revenues of over RMB 100 million for enterprises. The project has received multiple authoritative awards, including the First Prize of the China Association of Inventions, the Second Prize of the China Ocean Engineering Consulting Association, and the Second Prize of the China Institute of Navigation, demonstrating a high level of technological advancement and industry influence. Overall, the project combines frontier innovation, platform capability, and industrialization potential. In the future, it can be further extended to higher-level autonomous navigation verification, high-fidelity modeling of complex environments, real-ship shadow testing, and intelligent decision support, showing broad development prospects and significant engineering application value.



Figure 1 Self-developed physical vessel platform

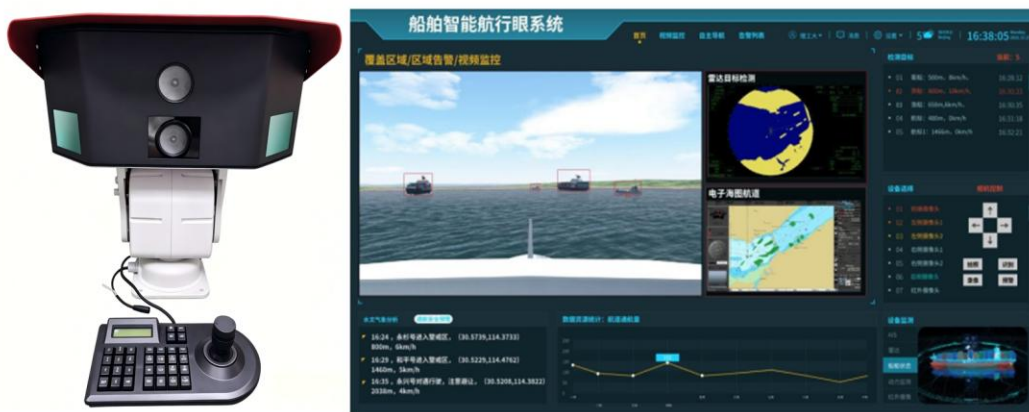


Figure 2 Holographic Perception System for Shore-Based Ship Remote Control

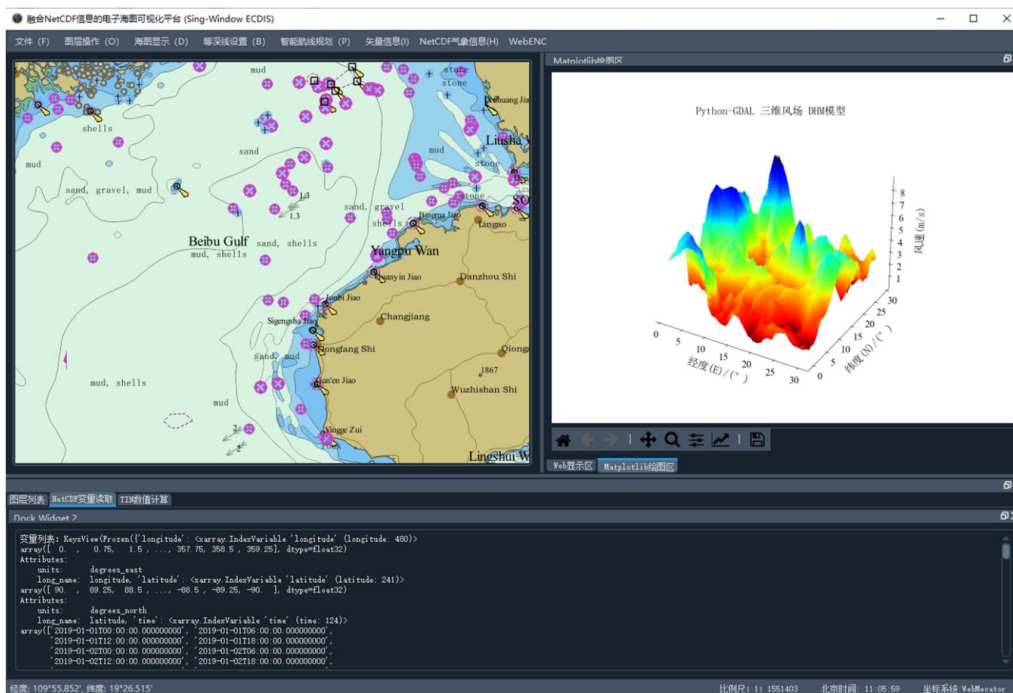


Figure 3 Electronic chart visualization platform



Figure 4 Virtual-real integration testing platform

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单位/公司介绍展板英文、图片内容（二）

Wuhan University of Technology

CAI No.04-2

Introduction :

Wuhan University of Technology is a key national university directly under the Ministry of Education of China. It was among the first universities selected for the national “211 Project” and the “Double First-Class” initiative, and it is jointly supported by the Ministry of Education and the Ministry of Transport, together with other ministries and commissions. The university traces its origins back to the Hubei Institute of Technology, founded in 1898. Over its 126-year history, especially during the past nearly 70 years, the university has educated nearly 700,000 high-level professionals. Among universities directly under the Ministry of Education, it has trained the largest number of talents for the building materials, construction, transportation, and automotive industries, and it has become an important base in China for cultivating high-level professionals and advancing scientific and technological innovation in these three major sectors. At present, the university has more than 37,000 full-time undergraduate students, more than 23,000 master’s and doctoral students, and more than 1,200 international students annually.

The university has established 52 national, provincial, and ministerial-level research bases, including the State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, the National Engineering Research Center for Fiber Optic Sensing Technology and Networks, the State Key Laboratory of Silicate Materials for Architectures, the National Engineering Research Center for Water Transport Safety, and the National Key Laboratory of Waterway Traffic Control. It has also established three provincial and ministerial collaborative innovation platforms: the Collaborative Innovation Platform for Inland Waterway Intelligent Shipping in the Transport Industry, the Hubei Collaborative Innovation Center for Automotive Components Technology, and the Hubei Collaborative Innovation Center for Safety Early Warning and Emergency Response Technology. The university has been approved as a pilot institution for the national strategy of building China into a leading transportation nation. It has also been selected as one of the first National Intellectual Property Model Universities and as one of the second group of university bases for the commercialization and technology transfer of scientific and technological achievements. Together with local governments and industry enterprises, it has established 211 collaborative institutions for scientific cooperation and technology commercialization, including off-campus research institutes, industry-university-research service platforms, and university-enterprise cooperation platforms. In 2023, the university received five National Science and Technology Awards, including three as the first completing institution, ranking among the top universities in China. Over the past five years, it has won one National Natural Science Award, two National Technological Invention Awards, and three National Science and Technology Progress Awards. It has also received 133 provincial and ministerial first prizes or above in science and technology, including 51 as the first completing institution. The university has been granted 5,830 invention patents and, as the first patent holder, has received five China Patent Awards. In addition, its researchers have published five papers in 《Science》 and six papers in 《Nature》 .

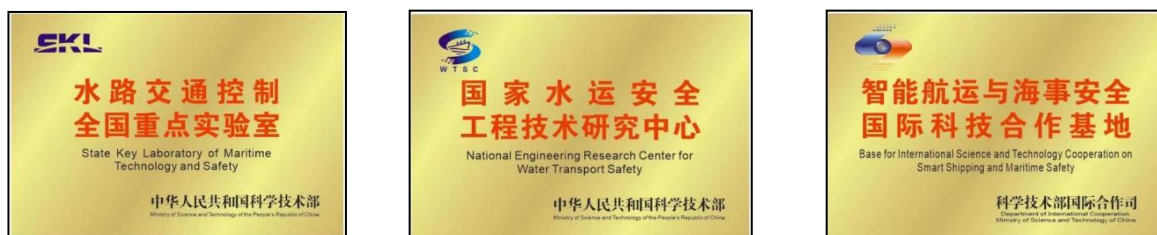


Figure 1 State Key Laboratories



Figure 1 Wuhan University of Technology

### **CETC Maritime Electronics Ltd.**

#### **Introduction :**

CETC Maritime Electronics Ltd. is a core research institution under China Electronics Technology Group Corporation, specializing in marine electronic information. Relying on the technological resources of a central state-owned enterprise, it focuses on the research and development of marine electronic equipment, technological innovation, and the commercialization of research achievements, serving as an important innovation platform for supporting China's national maritime strategy and promoting the development of smart ocean technologies and the marine electronics industry. The institute has developed strong expertise in key areas including marine monitoring, shipborne electronics, port and shipping informatization, and unmanned intelligent marine equipment. It possesses full-chain capabilities covering key technology research, product development, system integration, and engineering application. The institute owns multiple independent intellectual property rights and core patents, and a number of its technological achievements have realized domestic substitution and been successfully applied in fields such as marine engineering, maritime supervision, and intelligent ships. The institute has established a sound scientific research and innovation platform together with a comprehensive quality assurance system. It actively promotes collaborative innovation among industry, universities, and research institutions, and works closely with universities, industrial enterprises, and local governments to accelerate the transformation and industrial incubation of marine electronic information technologies. It has undertaken a number of national-level and provincial- or ministerial-level research projects, received multiple science and technology awards, and become an important carrier for regional technological innovation in marine electronic information, advanced equipment development, and the gathering of high-level talents.



Figure 3 CETC Maritime Electronics Ltd.