### 附件 2-1 E-NNOVATE 2025 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. 02-1

Invention: USV formation path-following method based on deep reinforcement learning 一种基于深度强化学习的无人船艇编队路径跟踪方法 Inventor(s): Ma Yong, Ma Yong, Zhao Yujiao, Li Lingyu, Wu Yixin, Xiao Junyang, Hu Ruidie, Chen Huihui, Li Qifeng, Gong Shenyi

Patent No.: ZL202010626769.X US11914376B2 ZL201810298448.4

#### Introduction:

This project has invented a deep reinforcement learning-based path tracking method for unmanned surface vessel formations. By innovatively designing a multi-vessel collaborative exploration architecture, dynamic joint reward function, and random noise-driven training strategy, it overcomes the technical bottleneck of traditional methods in coordinately optimizing path tracking accuracy and formation stability in complex water environments. The technology pioneeringly integrates leader-follower models with deep reinforcement learning frameworks, establishing a composite reward model incorporating formation stability errors and path tracking errors. It introduces a virtual leader dynamic projection mechanism and adaptive noise attenuation strategy, significantly enhancing the formation's dynamic adjustment capabilities and system convergence efficiency. The technology has been successfully implemented by multiple enterprises including CETC and Zhejiang Jialan, supporting intelligent upgrades in maritime equipment and generating cumulative sales exceeding 100 million yuan. Recognized with prestigious honors such as the First Prize from China Invention Association, Second Prize from China Association of Oceanic Engineering, and Second Prize from China Institute of Navigation, the innovation substantially improves operational safety and energy efficiency in complex waterway inspection and marine monitoring scenarios. It provides core technical support for China's maritime power strategy while promoting intelligent transformation in the shipping industry and developing new quality productive forces.





Fig1 Intelligent navigation system



Fig2 Navigation Eye System



Fig3 USV formation control terminal

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## 附件 2-2 E-NNOVATE 2025 波兰国际创新展览会线上展

CAI No. 02-2

# 单位/公司介绍展板英文、图片内容(二)

Wuhan University of Technology

Introduction:



Fig1 Wuhan University of Technology



Fig2 State Key Laboratory

Wuhan University of Technology (WUT) is a national key university directly under the Ministry of Education, among the first institutions included in China's National "211

Project" and "Double First-Class" Initiative. Co-established by the Ministry of Education and Ministry of Transport, the university traces its academic roots to Hubei School of Crafts founded in 1898. Over its 126-year history, particularly in the past seven decades, WUT has nurtured nearly 700,000 high-level professionals, making it the largest talent cultivation base under the Ministry of Education for building materials/construction, transportation, and automotive industries. It stands as a crucial national base for cultivating high-level talents and advancing technological innovation in these "Three Major Industries".

Currently, WUT hosts over 37,000 undergraduate students, 23,000 doctoral and master's candidates, and maintains a full-year enrollment of more than 1,200 international students.

The university boasts 52 national and ministerial-level research platforms, including:

- National Key Laboratory of Advanced Composite Materials
- National Engineering Research Center for Fiber Optic Sensing Technology and Networks
- National Key Laboratory of Silicate Building Materials
- National Engineering Research Center for Water Transport Safety
- National Key Laboratory of Waterway Traffic Control

It also operates three ministerial collaborative innovation platforms:

- Inland Intelligent Shipping Collaborative Innovation Platform
- Hubei Collaborative Innovation Center for Automotive Components Technology

- Hubei Collaborative Innovation Center for Safety Warning and Emergency Response Technology

Recognized as a pilot unit for building China into a transport powerhouse, WUT has been designated among the first National Intellectual Property Model Universities and included in the second batch of National Bases for University Scientific Achievements Transformation. The university has collaborated with local governments and industries to establish 211 scientific cooperation institutions, including joint research institutes, industry-academia-research platforms, and enterprise-university technology centers.

In 2023, WUT won five National Science and Technology Awards, including three first-completed projects, positioning the university among China's top academic institutions. Over the past five years, the university has achieved:

- 1 National Natural Science Award
- 2 National Technology Invention Awards
- 3 National Science & Technology Progress Awards
- 133 provincial/ministerial-level top scientific awards (51 as primary contributor)
- 5,830 authorized invention patents
- 5 China Patent Awards (as primary patent holder)
- Published 5 papers in Science and 6 papers in Nature

This remarkable record underscores WUT's leading position in scientific innovation and its contributions to China's technological advancement.





Ma Yong, recipient of the National Science Fund for Excellent Young Scholars and Principal Investigator of the National Key R&D Program of China, serves as Chief Scientist for "Intelligent Ship Navigation Control" at the National Key Laboratory of Waterway Traffic Control. He has been recognized as a Youth Science and Technology Elite by the Ministry of Transport and serves on the Committee of Intelligent Command and Control System Engineering within the Chinese Institution of Command and Control.

As leader of a provincial innovation research team and Deputy Director of the International S&T Cooperation Base for "Intelligent Shipping and Maritime Safety" under the Ministry of Science and Technology, he was listed in the 2024 Global Top 2% Scientists ranking. He holds editorial positions as Associate Editor of IEEE Transactions on Industrial Informatics (TII) and serves as Professor, PhD Supervisor, and Associate Dean at the Wuhan University of Technology.

Dedicated to fundamental research in unmanned surface vehicle (USV) autonomous navigation safety, he has achieved full-chain innovation encompassing "complex scenario design - theoretical methodology development - system equipment R&D - standard formulation - practical application", establishing a comprehensive technological system for USV autonomous safe navigation. He has led 8 national-level projects and 6 ministerial/provincial-level research initiatives.

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