发明项目展板英文图片内容(一)

Invention: Intelligent Securing and Safety Assessment of Heavy and Oversized Cargo in Land and Sea Transport

重大件货陆海联运智能系固与安全评估

Inventor(s): Zunfeng Du; Haiming Zhu; Muxuan Han; Junling Wu; Jingbo Yang

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Introduction：

Heavy and oversized cargo has enormous dimensions, excessive weight, and complex structures, making its securing process challenging and risky. The securing system's design, verification, implementation, and monitoring constitute critical processes and key technologies throughout transportation. The team has developed an engineering-based verification method for cargo securing, ensuring transport safety and efficiency while driving intelligent and integrated upgrades in supporting industries, including rigging, ports, and sensing.

● Advantages and significance of the invention:

1) Considering the uncertain and complex engineering environment, we established a rigid-flexible coupled and nonlinear mechanical model of the 'vehicle-cargo-lashing' multi-body system to reveal damage-failure mechanisms and positive feedback evolution (Fig. 1). Using a swarm intelligence optimization algorithm, we solved the multi-parameter optimization problem, enabling automated and intelligent generation of securing solutions. This approach forms an integrated design and decision-making methodology for heavy and oversized cargo transport securing systems, overcoming conventional experience-dependent and simplified estimation methods to improve solution optimization and enhance securing reliability (Fig. 2).

2) An online monitoring and real-time safety assessment solution for heavy and oversized cargo transport securing systems is established (Fig. 3). By implementing digital twin technology, novel intelligent rigging and sensing technologies are developed, creating a reliability theory-based evaluation framework for assessing the effectiveness of securing components and safety margins. Based on historical operational data, this system enables real-time safety level prediction through digital twin simulation, offline learning, and self-correction capabilities.

3) An intelligent security, online monitoring, and safety assessment system was developed for land and sea transport of heavy and oversized cargo. The system integrates five key modules: intelligent design, digital twin, intelligent assessment, condition sensing, and iterative upgrading, while combining three core functions: solution design during the planning phase, monitoring/warning during the execution phase, and self-iterative upgrading post-transport. It enables multi-departmental collaborative communication and data transmission, dynamically coordinating module operations and allocating computing resources.

● Application and Economic Benefits:

The achievements include one published academic monograph, over 150 research papers, 30 authorized invention patents, and five registered software copyrights. The team has participated in developing 20 national standards (including four military standards). These technological innovations have been successfully deployed for multimodal transportation (rail/road/maritime) of heavy defense equipment, generating cumulative economic benefits exceeding 1 billion RMB while demonstrating strong potential for expanded applications (Fig. 4).
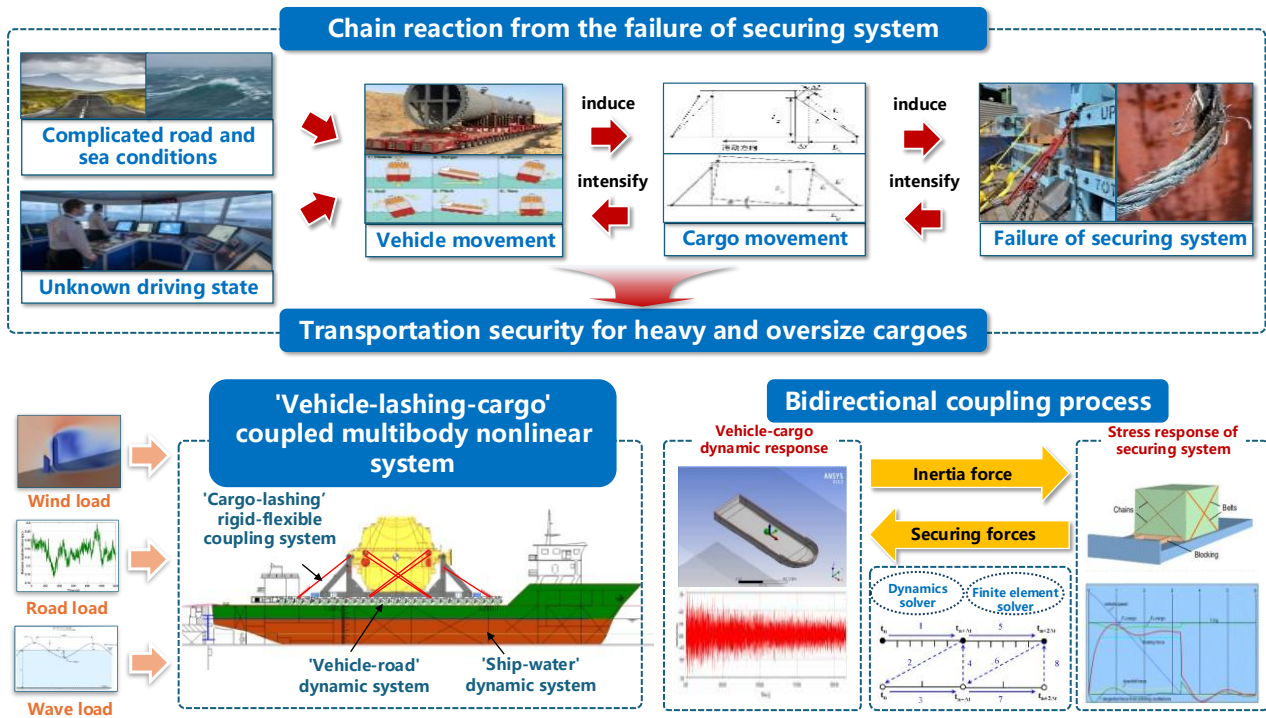

Fig.1 Study on the rigid flexible coupling mechanics model and failure mechanism of transportation system
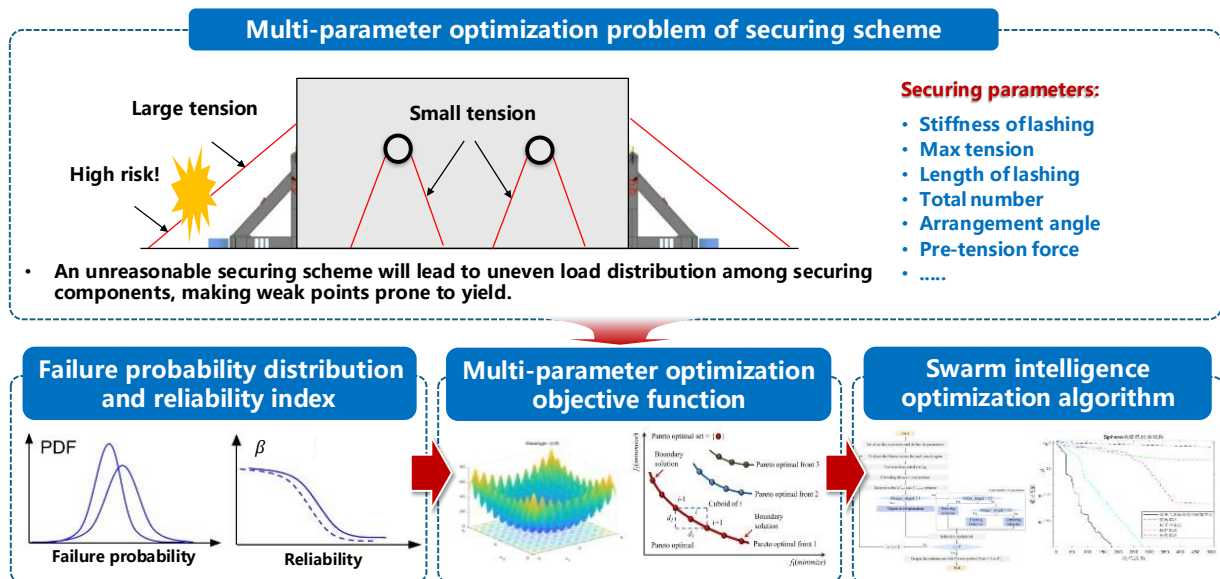

Fig 2 Research on Key Technologies for Intelligent Design of Securing Solutions
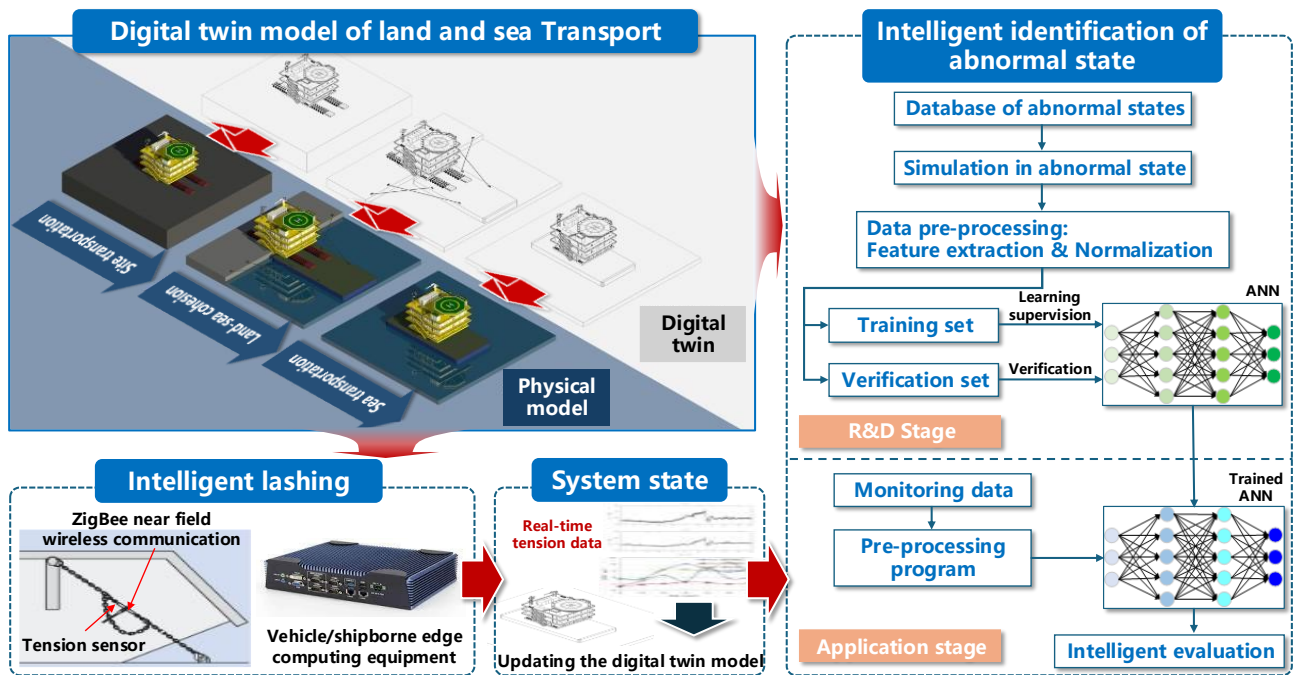
Fig. 3 Research on Online Monitoring and Real time Safety Assessment of Securing System

Fig. 4 Research achievements and Application Scene

Please contact

Name: Du Zunfeng

Company/Unit: Tianjin University, China

Address: School of Civil Engineering, Tianjin University, 300350 Tianjin, China

Tel: 0086-022-27406103   Mobile: 0086-13752692123   E-mail: dzf@tju.edu.cn

附件 2-2　　E-NNOVATE 2025 波兰国际创新展览会线上展单位/公司介绍展板英文、图片内容（二）

Tianjin University　　　CAI No. 06-2

Introduction：

　　Tianjin University (TJU), founded on October 2, 1895, as Peiyang University, is China's first modern university and a pioneer of modern Chinese higher education (Fig. 1).

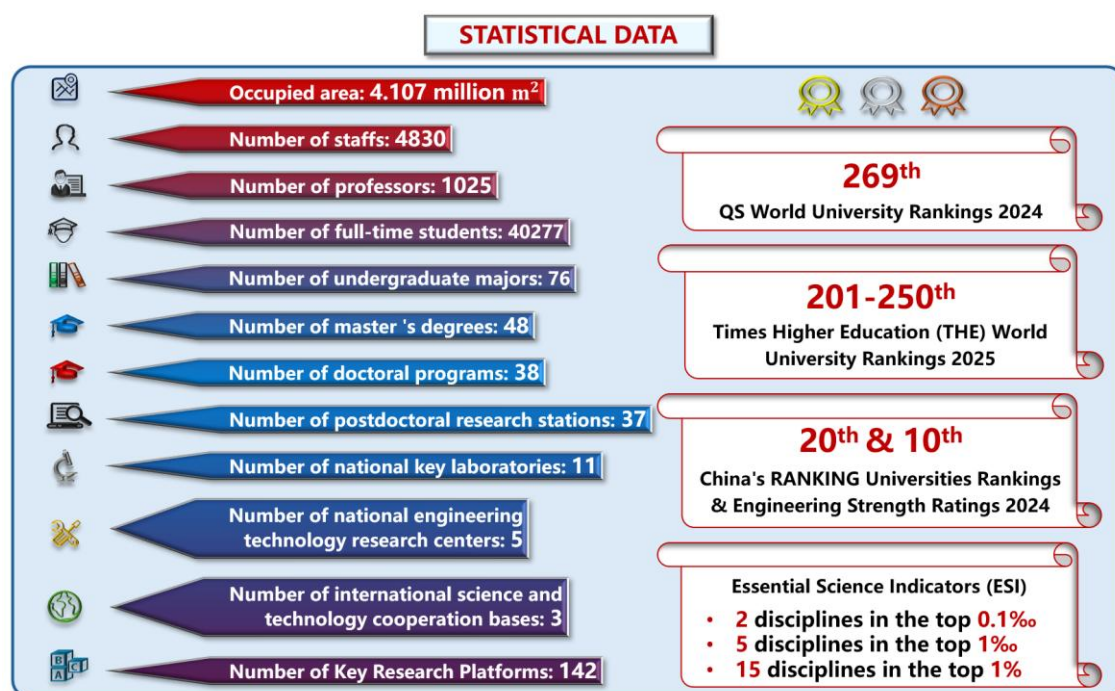　　TJU achieved the following rankings (Fig. 2):

- QS World University Rankings 2024: 269th (11th in China);
- Times Higher Education (THE) World University Rankings 2025: 201- 250th (16th in China);
- Best Chinese Universities Ranking 2024: 20th;
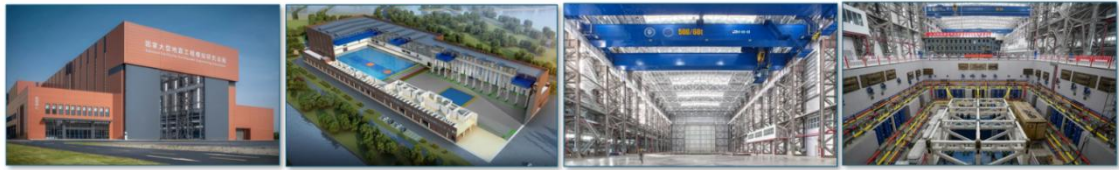- Chinese University Engineering Strength Rating 2024: 10th.

　　TJU has 15 disciplines ranked in the top 1% of the Essential Science Indicators (ESI) database, including 5 in the top 1‰ and 2 (Engineering and Chemistry) in the top 0.1‰.

　　This invention is developed based on national research platforms at Tianjin University, including the National Facility for Earthquake Engineering Simulation and the State Key Laboratory of Hydraulic Engineering Intelligent Construction and Operation (Fig. 3).

　　The school adheres to the principle of opening up to the world and deepening international exchanges and cooperation in an all-round way. TJU has cooperated with 260 universities, research institutes, and companies in 50 countries and regions (Fig. 4).

For a long time, through the unremitting efforts of all teachers and students, Tianjin University has become a high-level research university with strong faculty, distinctive discipline characteristics, first-class education quality, and scientific research level in China, and a significant influence in the world.

STATISTICAL DATA

Occupied area: 4.107 million m²
Number of staffs: 4830
Number of professors: 1025
Number of full-time students: 40277
Number of undergraduate majors: 76
Number of master 's degrees: 48
Number of doctoral programs: 38
Number of postdoctoral research stations: 37
Number of national key laboratories: 11
Number of national engineering technology research centers: 5
Number of international science and technology cooperation bases: 3
Number of Key Research Platforms: 142

269th
QS World University Rankings 2024

201-250th
Times Higher Education (THE) World University Rankings 2025

20th & 10th
China's RANKING Universities Rankings & Engineering Strength Ratings 2024

Essential Science Indicators (ESI)
- 2 disciplines in the top 0.1‰
- 5 disciplines in the top 1‰
- 15 disciplines in the top 1%

National Facility for Earthquake Engineering Simulation

State key laboratories

International   Qualification

The Digital Freight and Intelligent Stowage Team（A group photo on Teachers' Day in 2024）

Please contact

Name: Du Zunfeng

Company/Unit: Tianjin University, China

Address: School of Civil Engineering, Tianjin University, 300350 Tianjin, China

Tel: 0086-022-27406103   Mobile: 0086-13752692123   E-mail: dzf@tju.edu.cn