THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

CNERC-Rail HK

National Rail Transit Electrification and Automation Engineering Technology Research Center (Hong Kong Branch)
國家軌道交通電氣化與自動化工程技術研究中心(香港分中心)

National Rail Transit Electrification and Automation Engineering Technology Research Center (Hong Kong Branch)

國家軌道交通電氣化與自動化工程技術研究中心香港分中心

2024 ANNUAL REPORT

(English Version)

Outline

Director's Foreword

As 2024 comes to an end, we reflect on the past year and recognize the significant achievements of the Hong Kong Branch of the National Rail Transit Electrification and Automation Engineering Technology Research Center (CNERC-Rail (HK Branch)) across various domains, including rail transit technology innovation, international collaboration, and talent development. Committed to technological advancement, coordinated growth, and societal service, we have remained steadfast in our mission. By confronting challenges with determination, continuously refining our expertise, and striving for excellence, we have made substantial progress in our pursuit of innovation and impact.

In the realm of scientific research, we have achieved significant advancements. This year, we made major breakthroughs in the intelligent operation and maintenance of rail transit and successfully secured approval to establish the PolyU-Hangzhou Technology and Innovation Research Institute. For technology innovation, we have independently developed an intelligent operation and maintain platform for rail transportation. The platform covers various operation and maintenance management field, including track maintenance, intelligent station yard maintenance, vehicle depot maintenance, rolling stock maintenance, and trackside monitoring, making significant contributions to enhancing operational efficiency and safety. For noise reduction, CNERC-Rail (HK Branch), in collaboration with CRRC Tangshan Co., Ltd., optimized the noise reduction solutions. We successfully developed an intelligent noise reduction barrier using optimized acoustic metamaterial model, achieving remarkable results. Additionally, we have also made breakthroughs in UAV-based geological disaster prevention, obstacle instruction detection, and intelligent maglev control. These breakthroughs not only accelerate the intelligent development of rail transit but also contribute significantly to the industry's sustainable growth. Furthermore, the "Intelligent tropical-storm-resilient system for coastal cities" project was officially launched, aiming to enhance the intelligent management of tropical storm risks. A key research outcome, "Increasing temporal stability of global tropical cyclone precipitation", was published in a Nature Partner Journals, highlighting our research excellence and global impact. Additionally, the centre's director, Prof. Yi-Qing Ni, received The Hong Kong Polytechnic University (PolyU) President's Awards for Outstanding Achievement, validating the significant contributions of entire team to scientific research.

In advancing technological transformation, we actively engage in initiatives to facilitate the application of scientific research outcomes. In June, we participated in the "Innovative π-Industry Science and Technology Innovation Conference" in Hangzhou, collaborating closely with government agencies, enterprises, and investment institutions to foster technical integration and cooperative exchanges in areas such as artificial intelligence, big data, and rail transit. These efforts have strengthened the pathway for translating technological innovations into practical applications, effectively driving the growth and development of related industries.

In supporting the advancement of rail transit in the Greater Bay Area (GBA), we hosted the 2nd Seminar on Maglev Train and Advanced Railway Transportation Development in the GBA, and the 2nd Greater Bay Area Modern Railway Transportation Technology Forum (Bay Area Forum) and the 4th Guangdong-Hong Kong-Macao Greater Bay Area Modern Railway Transportation Co-Innovation Center Annual Conference. These events have established a strong foundation for promoting innovation and international collaboration in high-speed rail and maglev technology, providing significant momentum for the continued development of rail transit in the GBA.

We have also achieved substantial progress in both domestic and international collaborations. In July, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), Nicholas Kwan, Deputy Head, and Dr. Pamela Tin, Research Director from the Government of the Hong Kong Special Administrative Region Chief Executive's Policy Unit, visited the CNERC-Rail (HK Branch). In-depth discussions were held on the potential development of maglev transportation, aimed at integrating Hong Kong into the national rail planning. In September, Wen-Bin Miao, member of the Standing Committee of the Taizhou Municipal Committee of Zhejiang Province, visited the CNERC-Rail (HK Branch) and signed multiple cooperation agreements with PolyU. These agreements have paved new paths for international collaboration in maglev transportation and intelligent operation and maintenance.

Looking ahead to 2025, we remain committed to our foundational mission, striving to advance innovation in intelligent rail transit operation, maintenance, and maglev technology while fostering deeper collaboration and exchange with various parties. Simultaneously, we further enhance investment in technological research and development, talent cultivation, and knowledge transfer, contributing even greater efforts to the advancement of Hong Kong and the GBA.

Yi-Qing Ni

Chair Professor

Yim, Mak, Kwok & Chung Endowed Professorship in Smart Structures

Director of National Rail Transit Electrification and Automation

Engineering Technology Research Center (Hong Kong Branch)

Director of the Hong Kong Polytechnic University

Hangzhou Technology and Innovation Research Institute

1. Overview of CNERC-Rail (HK Branch) in 2024

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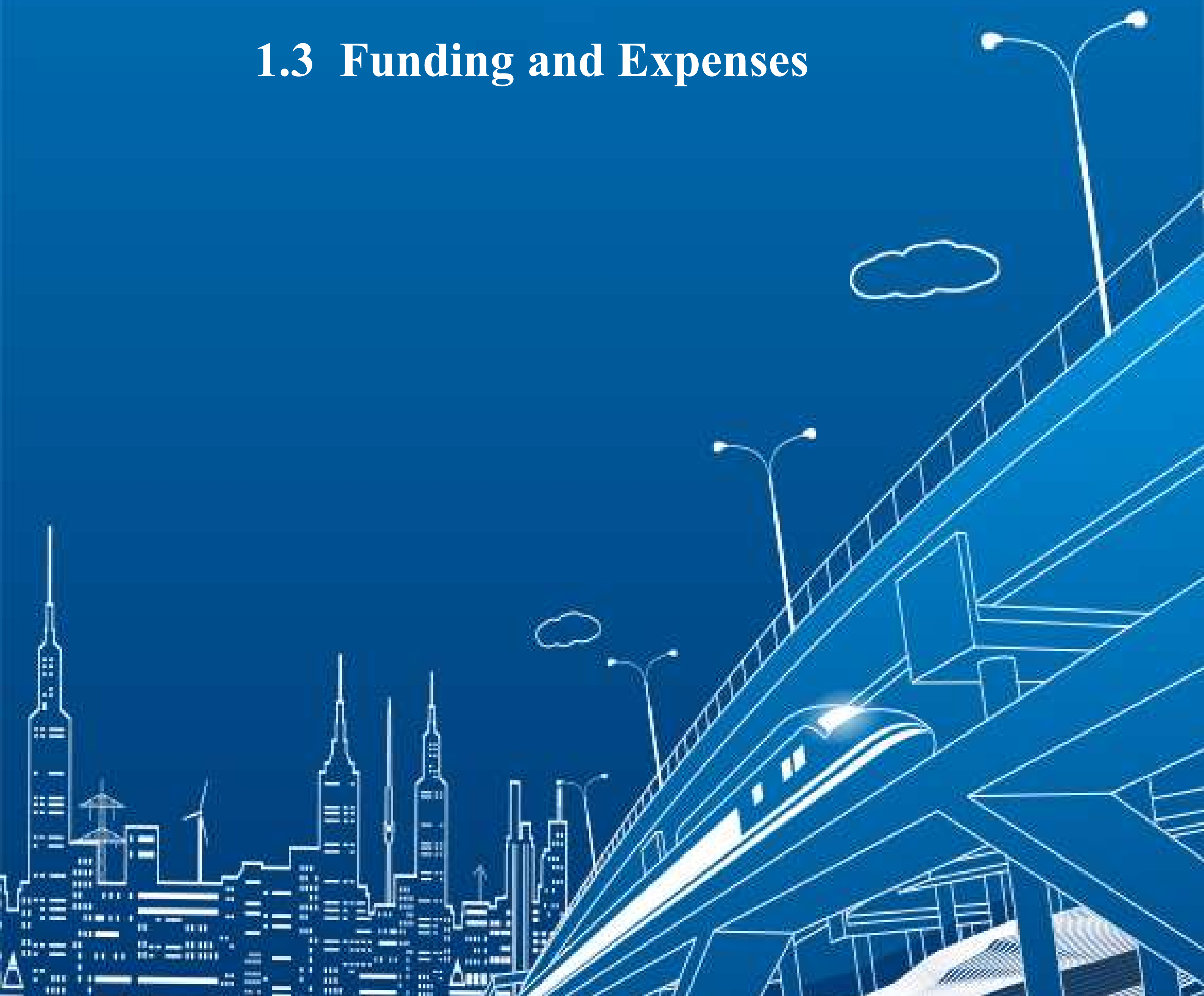


1 Overview of CNERC-Rail (HK Branch) in 2024

1.1 Introduction

The National Rail Transit Electrification and Automation Engineering Technology Research Center Hong Kong Branch, CNERC-Rail (HK Branch), was established in 2015 upon approval by the Ministry of Science and Technology of the People's Republic of China. It affiliates to the Hong Kong Polytechnic University (PolyU) and operates under the management of the university. It receives financial support regarding research and daily operations from the Innovation and Technology Commission (ITC) of the Hong Kong SAR Government and the PolyU. CNERC-Rail (HK Branch) has built up an interdisciplinary research team taking advantage of research resources in advanced sensing, smart materials, and data-driven analysing techniques available in the university.

<u>Mission:</u> To develop state-of-the-art monitoring technologies embracing smart materials and advanced big data analysis methods for the rail transit system.

<u>Vision:</u> To accelerate the process of constructing intelligent rail transit including high-speed rail, metro, and maglev systems concerning safety and reliability, promoting innovative monitoring technologies for rail transit from Hong Kong to Asia and worldwide.

CNERC-Rail (HK Branch) has achieved fruitful outcomes in terms of academic research, and engineering application in 2024 through undertaking scientific research projects, performing engineering and consultancy services, and strengthening partnership with other research institutes and enterprises.

Major items of work of CNERC-Rail (HK Branch) in 2024 are presented in detail in the following sections.

1.2 Research Teams

CNERC-Rail (HK Branch) consists of 11 key members (see Table 1.1) and two collaborative members (see Table 1.2) from different departments who lead R&D projects. To strength its research capability and to enable efficient execution of research tasks, CNERC-Rail (HK Branch) also actively recruits research talents from worldwide (see Table 1.3) to participate in R&D projects.

Table 1.1 Key members of CNERC-Rail (HK Branch)

No.	Name and Position	Department	Remark
1	Yi-Qing Ni, Chair Professor	Department of Civil and Environmental Engineering	Director
2	Kang-Kuen Lee, Professor	Department of Electrical and Electronic Engineering	Deputy Director
3	Hwa-Yaw Tam, Chair Professor	Department of Electrical and Electronic Engineering	Project Leader
4	Li Cheng, Chair Professor	Department of Mechanical Engineering	Project Leader
5	Jiannong Cao, Chair Professor	Department of Computing	Project Leader
6	Xiao-Li Ding, Chair Professor	Department of Land Surveying and Geo-informatics	Project Leader
7	Ka-Wai Cheng, Professor	Department of Electrical and Electronic Engineering	Project Leader
8	Siu-Wing Or, Professor	Department of Electrical and Electronic Engineering	Project Leader
9	Zhongqing Su, Professor	Department of Mechanical Engineering	Project Leader
10	Dan Wang, Professor	Department of Computing	Project Leader
11	Songye Zhu, Professor	Department of Civil and Environmental Engineering	Secretary

Table 1.2 Collaborative members of CNERC-Rail (HK Branch)

No.	Name and Position	Department	Remark
1	Siu-Kai Lai, Associate Professor	Department of Civil and Environmental Engineering	Project Leader
2	You Dong, Associate Professor	Department of Civil and Environmental Engineering	Project Leader

Table 1.3 Recruited staff of CNERC-Rail (HK Branch)

No.	Name	Position	Period of Employment	
1	You-Wu Wang	Research Assistant Professor, Senior Research Fellow	2021-01-04	2026-06-30
2	Su-Mei Wang	Research Assistant Professor	2021-09-01	2025-06-30
3	Wai-Kei Ao	Research Assistant Professor	2022-08-29	2025-06-30
4	Zheng-Wei Chen	Research Assistant Professor	2022-08-29	2025-06-30
5	Hong-Wei Li	Research Assistant Professor	2023-07-01	2025-06-30
6	Si-Qi Ding	Research Assistant Professor	2024-02-19	2026-06-30
7	E Deng	Postdoctoral Fellow, Research Fellow	2022-06-13	2025-06-12
8	Wen-Qiang Liu	Research Fellow	2023-10-05	2025-10-04
9	Si-Xin Chen	Research Fellow	2024-07-02	2024-08-31
10	Tai-Tung Wai	Research Technical Assistant	2017-01-23	2027-01-22
11	Wing-Hong Kwan	Research Technical Assistant	2017-10-04	2025-03-31
12	Min Deng	Research Technical Assistant	2024-04-01	2025-09-24
13	Wen-Bo Hu	Postdoctoral Fellow	2023-08-28	2025-08-27
14	Zi-Jian Guo	Postdoctoral Fellow	2023-11-13	2025-11-12
15	Yue Dong	Postdoctoral Fellow	2024-02-22	2025-02-21

16	Chao Yang	Postdoctoral Fellow	2024-03-01	2026-05-14
17	Xiao-Ming Tan	Postdoctoral Fellow	2024-03-19	2026-03-18
18	Yun-Fan Yang	Postdoctoral Fellow	2024-05-06	2026-05-05
19	Qi-Wu Zhu	Postdoctoral Fellow	2024-06-18	2026-06-17
20	Jamal Deen MUSAH	Postdoctoral Fellow	2024-07-02	2025-06-30
21	Zhi Li	Postdoctoral Fellow	2024-08-29	2026-08-28
22	Yang Zhang	Postdoctoral Fellow	2022-11-01	2024-07-08
23	Duo Zhang	Postdoctoral Fellow	2022-05-16	2024-05-15
24	Zi-Yu Tao	Postdoctoral Fellow	2022-07-18	2024-07-17
25	Chang-Chang Wang	Postdoctoral Fellow	2022-08-10	2024-06-28
26	Wei Jiang	Postdoctoral Fellow	2022-12-02	2024-05-31
27	Yuan-Peng He	Postdoctoral Fellow	2023-02-06	2024-09-30
28	Wei Liu	Postdoctoral Fellow	2023-02-28	2024-02-27
29	Mujib Olamide ADEAGBO	Postdoctoral Fellow	2023-05-15	2024-04-12
30	Omid HAJIZAD	Postdoctoral Fellow	2023-03-01	2024-08-28
31	Ru-Yang Yin	Postdoctoral Fellow	2023-09-28	2024-08-01
32	Si-Yi Chen	Research Associate, Postdoctoral Fellow	2023-09-01	2025-07-31
33	Xiu-Yu Chen	Research Associate, Postdoctoral Fellow	2024-02-28	2027-02-12
34	Yao Hu	Research Associate, Postdoctoral Fellow	2024-10-03	2027-02-12
35	Jun-Ping Zhong	Research Associate	2024-07-15	2025-07-15
36	Xin Ye	Research Associate	2024-01-03	2024-06-18

37	Yuan-Hao Wei	Research Associate	2024-01-29	2024-07-28
38	Yang Lu	Research Assistant	2023-04-01	2025-03-31
39	Lei Yuan	Research Assistant	2024-01-22	2025-07-21
40	Shuo Hao	Research Assistant	2024-09-01	2025-02-28
41	Zhen Lin	Research Assistant	2024-09-01	2025-03-31
42	Qi-Fan Zhou	Research Assistant	2021-03-08	2025-08-20
43	Yu-Ling Wang	Research Assistant	2021-04-14	2024-12-31
44	Guang-Zhi Zeng	Research Assistant	2022-10-28	2024-04-30
45	Zhan-Hao Guo	Research Assistant	2023-03-01	2024-02-29
46	Huan Yue	Research Assistant	2023-07-13	2026-01-10
47	Xin-Yuan Liu	Research Assistant	2023-07-13	2026-01-10
48	Kang Cai	Research Assistant	2023-10-26	2024-04-26
49	Cong-Guang Zhang	Research Assistant	2024-02-20	2025-02-19
50	Ao Zheng	Research Assistant	2024-06-03	2025-06-02
51	Zu-Yu Xie	Research Assistant	2024-07-11	2026-01-08
52	Yi-Ming Ni	Research Assistant	2024-08-15	2025-08-14
53	Liang-Sheng Qiu	Research Assistant	2024-08-19	2025-08-19
54	Huan-Zi Liu	Research Assistant	2024-09-02	2025-02-28
55	Yu-Hang Lu	Research Assistant	2024-09-12	2025-09-12
56	Qian Xiang	Research Assistant	2024-09-20	2025-03-19
57	Yu-Chen Liu	Research Assistant	2024-11-18	2025-05-17

58	Xin-Ge Zhao	Research Assistant	2024-07-01	2024-08-30
59	Xiang-Xiong Li	Research Assistant	2021-07-15	2024-12-31
60	Yu-Xuan Liang	Research Assistant	2022-11-07	2024-05-06
61	Jian Zhou	Research Assistant	2023-03-30	2024-08-31
62	Ying-Nan Hu	Research Assistant	2023-07-03	2024-7-19
63	Qing-Chen Tang	Research Assistant	2023-08-31	2024-07-17
64	Tsz Ying Leung	Research Assistant	2024-02-01	2025-06-30
65	Han-Zhang Lu	Research Assistant	2022-11-01	2024-07-31
66	Guang Zhou	Technician	2018-04-01	2025-4-30
67	Kai-Yuen Wong	Principal Research Fellow (PT)	2023-11-27	2026-11-26
68	Wai-Lun Ho	Principal Research Fellow (PT)	2023-11-01	2024-04-30
69	Shuk-Ching Cheung	Senior Research Fellow (PT)	2023-11-01	2024-04-30
70	Chi-Ming Tang	Research Fellow (PT)	2022-08-01	2025-07-31
71	Tsz-Kin Cheung	Research Associate (PT)	2023-11-01	2024-04-30
72	Xiao-Cheng Zhang	Research Assistant (PT)	2024-10-28	2025-01-31
73	Chi-Shing Liu	Research Assistant (PT)	2022-03-01	2024-02-28
74	Ji-Wei Ye	Student Assistant (PT)	2023-09-12	2025-06-30
75	Wing-Laam Yau	Student Assistant (PT)	2024-09-02	2025-02-28
76	Yu-Ze Nian	Postdoctoral Fellow	2024-11-11	2025-03-18
77	Zi-Mo Zhu	Postdoctoral Fellow	2024-01-01	2024-07-25
78	Yang Deng	Research Associate	2023-10-03	2024-03-31

79	Zhen-Dong Li	Research Associate	2024-08-03	2025-02-07
80	Chi Zhang	Research Assistant	2024-03-19	2024-08-31
81	Yu-Duo Zhao	Research Assistant	2024-07-02	2025-01-01
82	Chen Gong	Research Assistant (PT)	2024-09-01	2025-08-31
83	Si-Hui Li	Research Assistant (PT)	2024-09-02	2025-08-31
84	Ze Liu	Research Assistant (PT)	2024-09-06	2024-11-06
85	Fu-Zhen Wen	Research Assistant (PT)	2024-11-15	2024-05-14
86	Guan-Nan Li	Research Assistant (PT)	2024-09-15	2024-12-31

1.3 Funding and Expenses

General breakdown for 2024:

1. Income: 22,000,000 HK Dollars	
ITC Funding	HKD 20,000,000.00
PolyU Funding	HKD 2,000,000.00
2. Expenses: 22,000,000 HK Dollars	
Research Projects	HKD 3,506,000.00
Human Resource	HKD 6,734,568.00
Equipment Purchase	HKD 7,796,024.00
General Expenses	HKD 3,963,408.00

2. R&D Activities of CNERC-Rail (HK Branch) in 2024

2.1 Research Projects

2.2 Research Progress

2.3 Research Outcomes

2 R&D Activities of CNERC-Rail (HK Branch) in 2024

2.1 Research Projects

2.1.1 Research Grants Applications

In 2024, the CNERC-Rail (HK Branch) led or collaborated in the submission of 24 research project proposals. Of these, 14 have successfully secured funding, with a total grant amount of approximately HK$17.5 million, while the remaining 12 are currently under review. The projects are funded by various sources, including a theme-based research scheme under the Research Grants Council (RGC) of the Hong Kong SAR Government, Innovation and Technology Commission (ITC) of the Hong Kong SAR Government and the Large Equipment Fund of The Hong Kong Polytechnic University. A list of concerned projects is given in Table 2.1.

Table 2.1 Projects seeking research grants in 2024

No.	Title	Funding Source	Amount	Status
1	A “Totally-additive-manufacturing”-driven new sensing technique for rapid health evaluation of space systems under hypervelocity impact of orbital junks	ITC Innovation and Technology Support Programme (Aerospace Technology)	HKD 4,471,200	Approved
2	Acoustic stethoscope integration and evaluation. Sub-project of “Mechanisms and key technologies of multi-sensory emulation wearable devices”	RGC Theme-based Research Scheme	HKD 2,890,000	Approved
3	Wearable portable fNIRS system for comprehensive evaluation of vibration, noise, and pressure comfort for high-speed trains	The Hong Kong Polytechnic University Large Equipment Fund	HKD 2,800,000	Approved
4	Energy efficiency in train operation: novel operation control strategy and smart suspension damper	MTR Research Funding Scheme	HKD 1,482,500	Approved
5	Research on modular integrated building system with interlocking stacked concrete structural modules and key technologies for performance monitoring. Subproject III: Key technologies for performance monitoring of interlocking stacked modular structures	China State Construction International Science & Technology R&D Project	HKD 1,151,800	Approved
6	Flow evolution characteristics, dynamic instability mechanism, and aerodynamic load rebalancing method for high-speed maglev train operational safety in time-varying wind environments: from numerical modelling to model testing	RGC General Research Fund	HKD 1,130,000	Approved
7	Exploration of structural noise control key technologies and applications	Midea Ltd.	CNY 1,000,000	Approved

8	Ultrafast laser-enabled three-dimensional characterization of stacked coatings	Research Grants Council, NSFC/RGC Joint Research Scheme	HKD 1,003,600	Approved
9	Research on health management technology of key components of rail vehicle bogies	Zhejiang Rail Transit Operation Management Group Co., Ltd. Technical Services	HKD 779,700	Approved
10	Advanced functional and smart materials for green energy, harsh-environment sensing, electromagnetic absorption, and electrochemical catalytic applications	Hong Kong Scholars Program 2024	HKD 461,200	Approved
11	Properties and mechanisms of layered double hydroxide-nanocarbon material nanocomposite fillers modified marine concrete	Start-up Fund for RAPs under the Strategic Hiring Scheme	HKD 150,000	Approved
12	Remote sensing of the bank slope of Dadu River Extra-Large Bridge	Technical Service from Sichuan Southwest Jiaotong University Railway Development Co., Ltd.	CNY 60,000	Approved
13	Energy harvesting using photovoltaic panel embedded in AI-designed smart concrete pavement system	RGC Theme-based Research Scheme	HKD 40,500,000	Pending
14	Detection of blockages of sight of drivers to traffic signs and signals using MMS data	Smart Traffic Fund	HKD 14,279,000	Pending
15	Urban resilience enhancement for energy-building-transport-water sector synergization (UREBTW) toolbox	Climate-Resilient Infrastructure Research Scheme	HKD 8,000,000	Pending
16	Optimization and regulation of lithium-sulfide cathodes for lithium-ion sulfur batteries of high energy density and high safety	Shenzhen-Hong Kong-Macao Science and Technology Plan Project 2024 (Category C)	CNY 3,000,000	Pending
17	Magnetorheological elastomer based tuned mass damper	Discovery Projects by Australian Research Council	AUD 509,400	Pending
18	Upcycling biochar-waste plastic composite into high-performance and low-carbon pavement materials	ITC	HKD 2,008,400	Pending
19	Photothermal polymer optical fibre-based soft actuators for atraumatic cochlear implantations	RGC General Research Fund	HKD 1,520,000	Pending
20	New technology for monitoring deformation of floating objects based on innovative integration of InSAR, GNSS and accelerometer measurements	RGC General Research Fund	HKD 1,480,100	Pending
21	RE-ASPHALT: Repurposing end-of-life wind turbine blades into a more sustainable pavement through Hierarchical characterization and accelerated long-term testing	RGC General Research Fund	HKD 1,468,700	Pending
22	Research on the entire process evolution law and risk identification model of underwater landslide disaster	RGC General Research Fund	HKD 968,000	Pending
23	Characterization and enhancement of the absorption and bonding of asphalt emulsion onto aggregate surface towards a high-performance low-carbon paving material	RGC General Research Fund	HKD 1,252,000	Pending

24	From pollution to solution: Valorization of nonmetallic fraction of printed circuit boards waste into high-performance and sustainable asphalt pavement	Environment and Conservation Fund	HKD 500,000	Pending

2.1.2 Research Projects Supported by CNERC-Rail (HK Branch)

In 2024, CNERC-Rail (HK Branch) has funded a total of 10 research projects, as listed in Table 2.2.

Table 2.2 Research projects supported by CNERC-Rail (HK Branch) in 2024

No.	Title	Principal Investigator	Department	Start-End Data
1	Meta-material assisted structural health monitoring for both thin and thick wall structures	Prof. Li Cheng	Department of Mechanical Engineering	2022-05-01 ~ 2024-01-31
2	Structural health monitoring with meta-materials for engineering structures pertinent to railway applications	Prof. Li Cheng	Department of Mechanical Engineering	2024-06-01 ~ 2026-05-30
3	Energy storage and charging techniques for partial catenary-free railway system	Prof. Ka-Wai Cheng	Department of Electrical and Electronic Engineering	2022-07-01 ~ 2024-03-31
4	Towards greener and artificial intelligence renewable energy devices and management systems for smart electrified urban transportation	Prof Siu-Wing Or	Department of Electrical and Electronic Engineering	2024-03-15 ~ 2027-03-14
5	Totally-additive-manufacturing" driven in situ health monitoring of CFRPs used in high-speed train structures	Prof. Zhongqing Su	Department of Mechanical Engineering	2024-07-11 ~ 2026-06-10
6	Predictive asset maintenance through intelligent algorithms	Dr. You Dong	Department of Civil and Environmental Engineering	2022-09-01 ~ 2024-02-29
7	In-SErvice diagnostics and intelligent maintenance of rail networks	Dr. You Dong	Department of Civil and Environmental Engineering	2024-01-01 ~ 2025-12-31
8	Thermal analysis of laminated window glass panels of high-speed trains under extreme conditions by using an advanced matched interface and boundary method	Dr. Siu-Kai Lai	Department of Civil and Environmental Engineering	2022-10-01 ~ 2024-03-31
9	Edge-cloud collaborative real-time railway monitoring platform	Prof. Jiannong Cao	Department of Computing	2022-11-01 ~ 2024-04-30
10	A metaverse system for the design and inspection of railway structures	Prof. Dan Wang	Department of Computing	2022-11-01 ~ 2024-04-30

2.1.3 Postdoctoral Research Supported by CNERC-Rail (HK Branch)

In 2024, CNERC-Rail (HK Branch) co-funded research works of 5 postdoctoral fellows in collaboration with The Hong Kong Polytechnic University through Postdoctoral Matching Fund Scheme. Project details are listed in Table 2.3.

Table 2.3 Postdoctoral research funded in 2024 by CNERC-Rail (HK Branch)

No.	PDF Name	Fund Scheme	Grant No.	Amount
1	Dr. Xiao-Ming Tan	Postdoctoral Matching Fund Scheme	K-BBY1/1-W32Z	HKD 365,400
2	Dr. Chao Yang	Postdoctoral Matching Fund Scheme	K-BBY1/1-W35L	HKD 365,400
3	Dr. Yun-Fan Yang	Postdoctoral Matching Fund Scheme	K-BBY1/1-W330	HKD 365,400
4	Dr. Qi-Wu Zhu	Postdoctoral Matching Fund Scheme	K-BBY1/1-W35Q	HKD 365,400
5	Dr. Zhi Li	Postdoctoral Matching Fund Scheme	K-BBY1/1-W35N	HKD 365,400

2.2 Research Progress

2.2.1 Intelligent Operation and Maintenance Platform for Rail Transportation

Prof. Yi-Qing Ni, Dr. You-Wu Wang, Dr. Qi-Wu Zhu, Mr. Yang Lu, and others from CNERC-Rail (HK Branch) have developed an integrated operation and maintenance management platform based on multiple online monitoring methods. The platform aims to enhance the operational efficiency of rail transit and improve passengers' travel experiences. As shown in Fig. 2.1, it enables early identification of potential issues and prevention of accidents through real-time monitoring and analysis. The platform covers various operation and maintenance management projects, including track maintenance, intelligent station yard maintenance, vehicle depot maintenance, rolling stock maintenance, and trackside monitoring, as illustrated in Fig. 2.2.

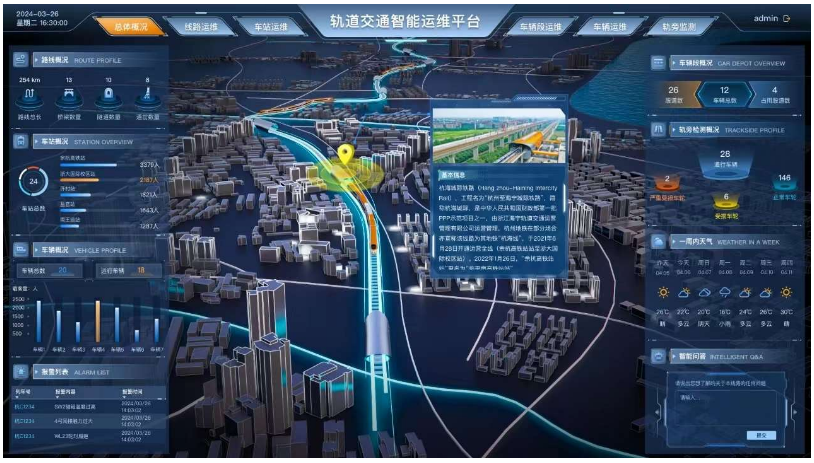


Fig. 2.1 Schematic diagram of intelligent operation and maintenance platform for rail transportation

In terms of track maintenance, the system monitors bridge and tunnel slopes, turnouts, as well as foreign object intrusions. Combined with manual and automated inspection management, it effectively evaluates infrastructure performance, promptly issues alerts, and ensures operational safety. The intelligent station yard maintenance system focuses on platform hazardous zones, elevator operations, passenger flow analysis, and emergency evacuation management. It detects potential events in advance, provides warnings, and optimizes train dispatching.

For vehicle maintenance, the platform monitors critical components such as bogies, carriage environments, and pantograph-catenary systems to assess and predict vehicle health status, offering optimal maintenance plans and evaluating vehicle safety. Additionally, the wayside operation and maintenance monitoring system includes an on-board diagnostic system for assessing and predicting the health status of certain bogie components, while also formulating corresponding maintenance plans.

Fig. 2.2 Subsystem schematic diagram: (a) line maintenance; (b) intelligent station yard maintenance; (c) depot maintenance; (d) vehicle operation and maintenance; (e) trackside monitoring

Overall, the CNERC-Rail (HK Branch) railway operation and maintenance management platform has provided strong support for the safe and efficient operation of rail transit by integrating multiple monitoring methods and management strategies.

2.2.2 Series of Vibration and Noise Tests on The MTR Tuen Ma Line (Ma On Shan-Wu Kai Sha Section)

The team from CNERC-Rail (HK Branch), including Dr. Wai-Kei Ao, Dr. Duo Zhang, Dr. Yuan-Peng He, Dr. Zi-Yu Tao, Dr. Xin Ye, Mr. Yu-Ling Wang, Mr. Yu-Xuan Liang, and Mr. Qing-Chen Tang, conducted specialized noise monitoring in the sound-sensitive areas of the Ma On Shan-Wu Kai Sha section of the Tuen Ma Line of MTR Corp Ltd from March 13-14, 2024, overnight between 22:00 and 24:00, as shown in Fig. 2.3. The study adopted the noise spectrum analysis method recommended by the International Organization for Standardization (ISO), combined with a high-precision acoustic sensor network, deploying 12 monitoring points along the tracks to focus on collecting rolling/friction noise characteristics at the rail-wheel contact surface during train passage.

Fig. 2.3 Schematic diagram of measuring points installed on site

(1) Noise sensitive receiver (NSR) testing

As illustrated in Fig. 2.4, the measured data indicates that during the non-decelerated operation period before 23:00—when the train maintains a speed of 80±2 km/h—the Ma On Shan-Wu Kai Sha one-way track generates substantial high-frequency friction noise. This phenomenon is attributed to deviations in the geometric parameters of the wheel-rail contact surface. The peak frequency band is concentrated at 3150 Hz, with an A-weighted sound pressure level reaching 70.4 dB. Sound waves in this frequency range exhibit the sharp characteristics typical of metal friction and are distinctly perceptible to the human ear. Further acoustic imaging analysis reveals that the abnormal noise sources are primarily located in track sections with a curve radius of less than 600 m and show a strong correlation with the superelevation design of the track.

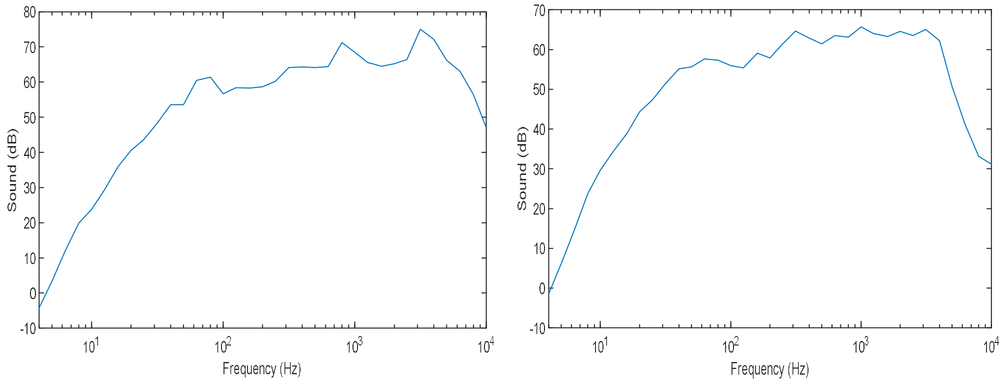


Fig. 2.4 1/3 octave analysis (around 11 p.m.)

(2) Trackside vibration and noise test series

The track conditions in this section exhibit the following characteristics: while the overall condition remains satisfactory, side wear is observed at certain bends. Additionally, the track's sound insulation panels are in poor condition, exhibiting multiple structural issues that compromise their functionality and may contribute to secondary noise generation. Furthermore, noise sources in this area are varied, necessitating further investigation to identify the primary source. Based on these characteristics, this study quantitatively assesses the noise levels during train operation to facilitate the development of appropriate mitigation measures, as shown in Fig. 2.5.

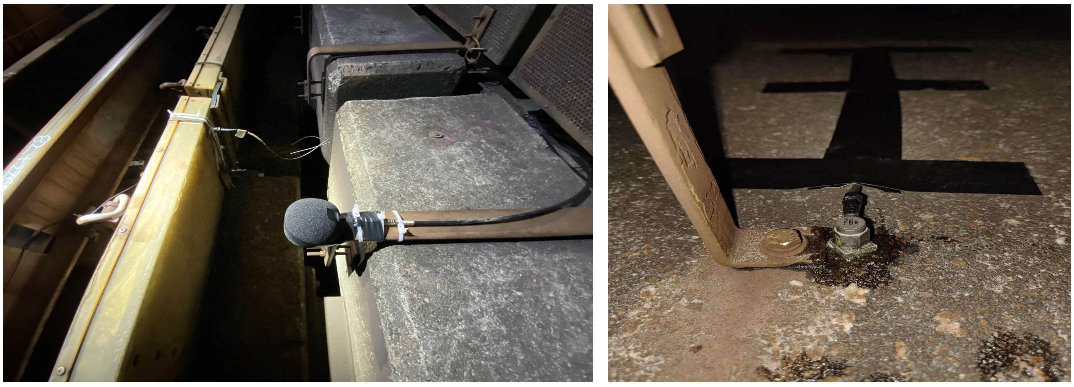


Fig. 2.5 Test points, field experimental setup and data acquisition systems

As shown in Fig. 2.6, the test results are as follows: The acceleration of the rails in both straight and curved sections remain within a controllable range, with vertical acceleration being more significant. In curved sections, acceleration increases due to centrifugal force, necessitating particular attention. The vertical acceleration of the track slab is within normal limits, with no abnormal vibrations detected. The lateral acceleration of the sound barrier remains low and is unaffected by train operations. The vibration frequencies of the rail, observed around 400 Hz and 1000 Hz, may contribute to noise issues. The track slab exhibits a frequency of 250 Hz, indicating no resonance and a reasonable design. However, the sound barrier frequency is recorded at 500 Hz, which is close to the rail's natural frequency, potentially increasing the risk of secondary vibrations, requiring continuous monitoring and further improvement.

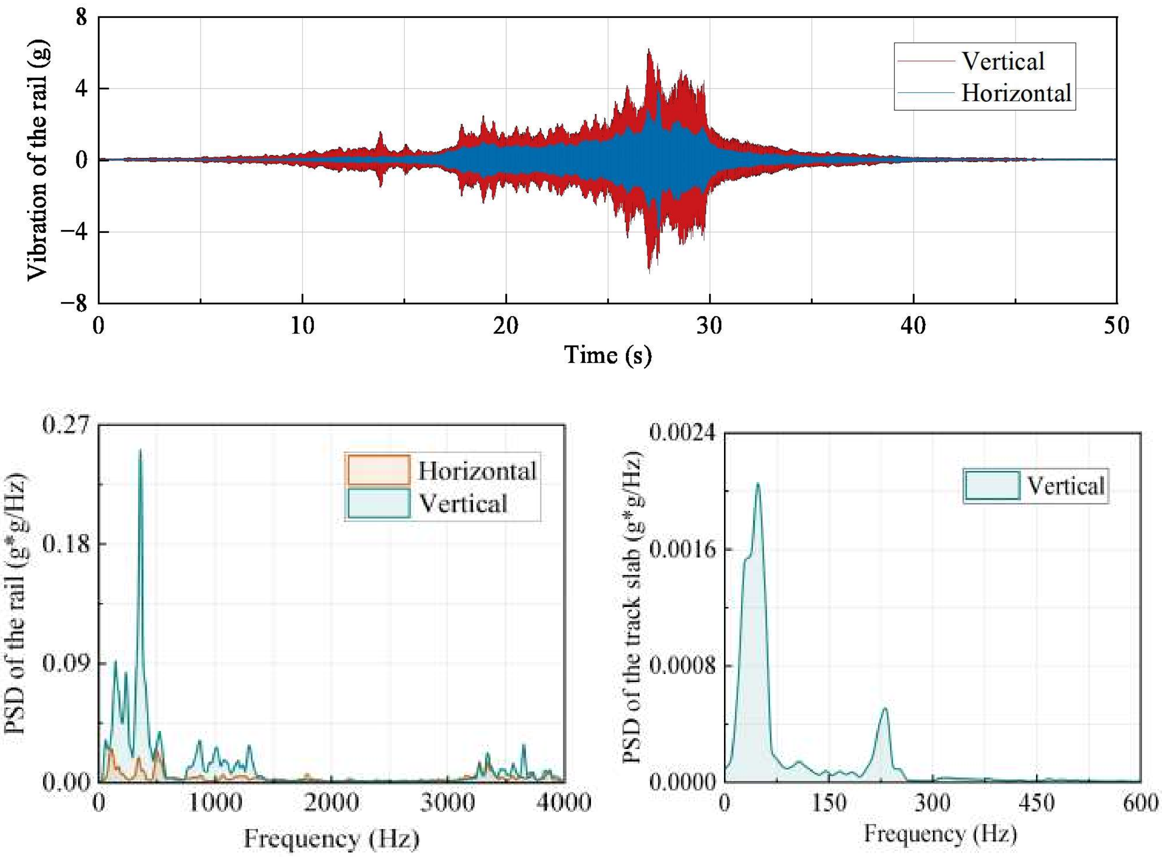


Fig. 2.6 Test results of some demonstrated time and frequency domain of vibration and sound pressure level

2.2.3 Noise Reduction Test of Track Particle Dampers for Train Squealing at MTR Kowloon Bay Depot

CNERC-Rail (HK Branch) has developed a new type of track damper based on particle damping technology for vibration and noise control in rail transit, and plans to conduct trials on MTR railway facilities. The trial site is the Kowloon Bay Depot (KBD), where nearby residents are concerned about the impact of train squealing noise on the local community. The track dampers were installed on a approximately 20 m long section of track between pedestrian walkways N04 and N74 at the KBD. Measurements were then taken to assess the noise reduction effect after the installation of the track particle dampers (see Fig. 2.7)

Fig. 2.7 On-site operations by CNERC-Rail (HK Branch) test crews

Researchers from the CNERC-Rail (HK Branch), including Research Assistant Professor Dr. Wai-Kei Ao, Dr. Zi-Jian Guo, Dr. Yun-Fan Yang, Dr. Xiao-Ming Tan, Mr. Cheng Peng and Mr. Yu-Ling Wang, participated in the field test. The test section was selected between pedestrian walkways N04 and N74 at the KBD. Under the half installation configuration involved 32 sets (64 units). The field layout and installed damper section are illustrated in Fig. 2.8. After the installation of the particle damper, measurements will be conducted to assess its effectiveness in noise reduction. Fig. 2.8 presents an on-site view of the damper installed on the track. Noise levels along the trackside will be recorded both before and after installation as trains enter and exit the depot. The evaluation will be based on an analysis of the average sound pressure level and octave band distribution to quantify the impact of the particle damper on noise mitigation.

Fig. 2.8 Schematic diagram of damper field installation

The key research findings are as follows: For train noise while entering the depot (measured over a 90 s LAeq), the noise level of the outer rail was reduced by 4.2 dB, while the inner rail experienced a reduction of 9.8 dB after the installation of the damper. Additionally, the damper demonstrated effective noise mitigation for the inner rail at frequencies above 160 Hz, achieving a maximum reduction of 7.8 dB at 1000 Hz. Similarly, for the outer rail, noise reduction was significant above 160 Hz, with a peak reduction of 6.9 dB at 5000 Hz. For train noise while leaving the depot (also measured over a 90 s LAeq), the outer rail noise decreased by 2.5 dB, and the inner rail noise was reduced by 6.4 dB. The damper was particularly effective in reducing noise for the inner rail above 400 Hz, with a maximum reduction of 8.3 dB at 3150 Hz, and for the outer rail above 315 Hz, achieving the highest reduction of 11.2 dB at 3150 Hz.

2.2.4 Conducting Dynamic Evaluation Tests on Damping Ring Performance

The field experiment aims to evaluate the noise levels inside the train body and near the wheels on the circular test track at the China Academy of Railway Sciences Group Co., Ltd. (CARS) in Beijing, as shown in Fig. 2.9. The primary objective of the experiment is to assess the changes in high-speed train noise before and after the installation of damping rings. This research is led by the CNERC-Rail (HK Branch) at The Hong Kong Polytechnic University, in collaboration with CRRC Tangshan Co., Ltd. The study employs non-destructive testing techniques to conduct a detailed analysis of the noise characteristics during high-speed train operation. The research team, comprising Research Assistant Professor Dr. Wai-Kei Ao, Mr. Yu-Ling Wang, Mr. Yu-Hang Lu, conducted data collection and analysis of noise levels under various operational conditions, including transient acceleration, deceleration, and steady-state operation, on November 25, 2024.

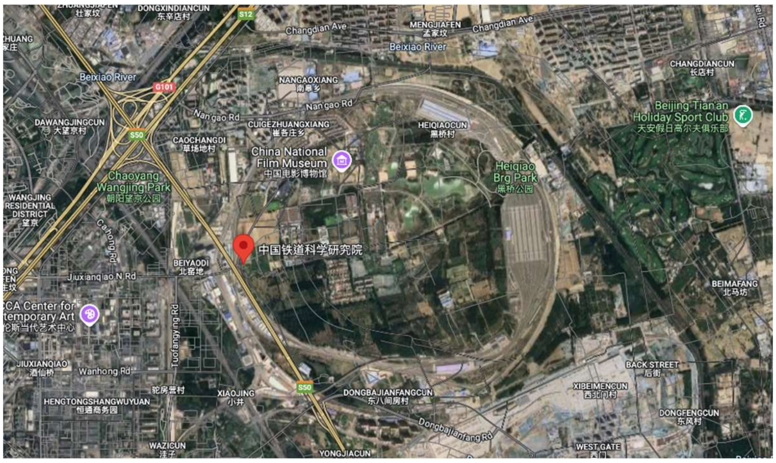


Fig. 2.9 Circular test track at the China Academy of Railway Sciences Group Co., Ltd.

The testing process at CARS is divided into multiple phases, including equipment installation, background noise acquisition, testing under transient dynamic acceleration and deceleration conditions, and noise measurement during steady-state operation. Noise data is primarily collected through microphone sensors positioned at specific locations inside and outside the train. To obtain critical acoustic data inside and around the high-speed train, CNERC-Rail (HK Branch) organized a testing team to conduct on-site measurements. Microphone sensors and four tri-axial accelerometers were used to capture the raw time histories of sound pressure and acceleration. Notably, measurement points TP1 to TP5 were designated for recording external sound pressure near the wheels, while TP6 to TP8 were positioned inside the train body to monitor internal noise pressure levels. Additionally, the tri-axial accelerometers were installed on the train floor.

Fig. 2.10 illustrates two distinct types of damping rings. Fig. 2.10(a) depicts the steel damping ring, while Fig. 2.10(b) shows the tuned mass damper (TMD) damping ring. It is important to note that all damping rings are installed within the concave grooves on the wheel surface. Additionally, the TMD damping ring is constructed by encasing the steel ring with rubber. The external microphone sensors are installed perpendicular to the wheel surface, while the internal microphone sensors are mounted at the midsection of the train body cross-section, positioned at least 1.5 meters above the floor.

(a) (b)

Fig. 2.10 Two different types of damping rings

Future research on damping rings will focus on understanding their mechanisms and exploring new materials. This emphasis aligns with the release of the national standard "Technical Requirements for Noise Reduction Rings in Urban Rail Transit Vehicles". The research team plans to further optimize the design parameters of damping rings, combining numerical simulations with experimental validation to establish a comprehensive wheel-rail noise prediction model, providing a more holistic solution for urban rail transit noise control. Additionally, the application of new composite materials in damping rings will be explored to enhance their noise reduction performance and service life, offering technical support for the green and sustainable development of the rail transit industry.

2.2.5 Application of UAV Technology in Geological Disaster Prevention Monitoring of Dadu River Mega Bridge

Dadu River Bridge is located in Luding County, Sichuan Province, at an altitude of 1300-1900 m. The bridge is a steel truss girder suspension bridge for two-lane railroad, which will become the world’s largest mountain railroad suspension bridge after completion. The project belongs to the key control project of Sichuan-Tibet Railway and is currently in the comprehensive construction stage. The bridge is located in the Sichuan Basin to the Tibetan Plateau transition zone, along the terrain of the high difference, steep slopes and deep valleys, for the typical high mountains and valleys, topography and regional geological structure is more complex. In addition, the bridge adopts tunnel anchor structure, which has higher requirements on coastal geology. Therefore, the traditional geological disaster prevention monitoring method has limitations, and it is necessary to use UAV aerial photography for building information modeling to carry out the geological disaster prevention monitoring of the bridge.

As shown in Fig. 2.11, Dr. Su-Mei Wang, Mr. Cong-Guang Zhang, Mr. Gao-Feng Jiang, and Ms. Xin-Yue Xu, members of CNERC-Rail (HK Branch), initially completed two drone aerial photography tasks on site on May 11, 2024: aerial photography of the 1:1000 3D point cloud model using the Dji Zenmuse L1 Lidar imitating ground flight, and 1:1000 aerial photography of the 1:1000 3D point cloud model using the Dji Zenmuse P1 mapping camera. The Dji Zenmuse P1 mapping camera was used to collect 1:1000 tilt photography data. The tilt photography data acquisition is designed to ensure the availability of raw image data under the complex conditions of large altitude difference in the survey area by dividing the operation area scientifically and designing multiple flight altitudes.

Fig. 2.11 UAV aerial photography mission site operations

2.2.6 Research on Obstacle Intrusion Detection Technology

From May 6 to 17, 2024, Ms. Xin-Yue Xu, Mr. Cong-Guang Zhang, and Mr. Gao-Feng Jiang, members of CNERC-Rail (HK Branch), conducted experiments at the Experimental Base of Sichuan Southwest Jiaotong University Railway Development Co., Ltd. The aim was to jointly develop a computer vision-based trackside multi-source data fusion system for obstacle intrusion monitoring. The system primarily consists of an optical camera, a LiDAR sensor, and an industrial computer, shown in Fig. 2.12. The camera and LiDAR are installed at fixed points along the trackside to capture high-resolution railway scene images with rich background information within the effective monitoring range. The collected on-site monitoring data are then transmitted to the industrial computer for storage and analysis. To enrich the obstacle intrusion scene dataset, the team utilized rain and fog simulation devices to replicate extreme weather conditions, such as heavy rain and dense fog, and conducted multiple sets of intrusion experiments. The extensive and diverse target and background data collected were used to construct a comprehensive obstacle intrusion image dataset for fully training deep learning models.

This study involves two main parts: (1) a proposed patch-level manifold distillation-based sunny-to-rain unsupervised domain adaption model for obstacle detection and (2) a proposed voxel-based obstacle detector utilizing point cloud data from LiDAR sensor which aims to detect unknown category obstacle detection. The former is based on the adaptive teacher paradigm, which uses patch-level information from the feature encoder to align the teacher and student models in the manifold space and reduces the domain gap through a rain-specific augmentation pipeline. It can achieve stable knowledge transfer from sunny to rainy domains and avoid pseudo-label bias to the source domain. At the same time, it can also segment the train ahead area. The latter first extracts the train ahead area in the 3D point cloud based on the track area mask output by the former and the camera-LIDAR calibration parameters, then adaptively voxelizes the key area and detects unknown category obstacles in the track area with higher risk level by counting the coordinates and quantity features of the point cloud in each voxel. Finally, the results of the above two methods are fused to obtain a comprehensive obstacle intrusion detection result, shown in Fig. 2.13. For example, the spatial distances of all detected objects in the image are calculated in the 3D point cloud. In summary, the proposed method achieves detection and distance estimation of common categories of objects through multi-sensor fusion.

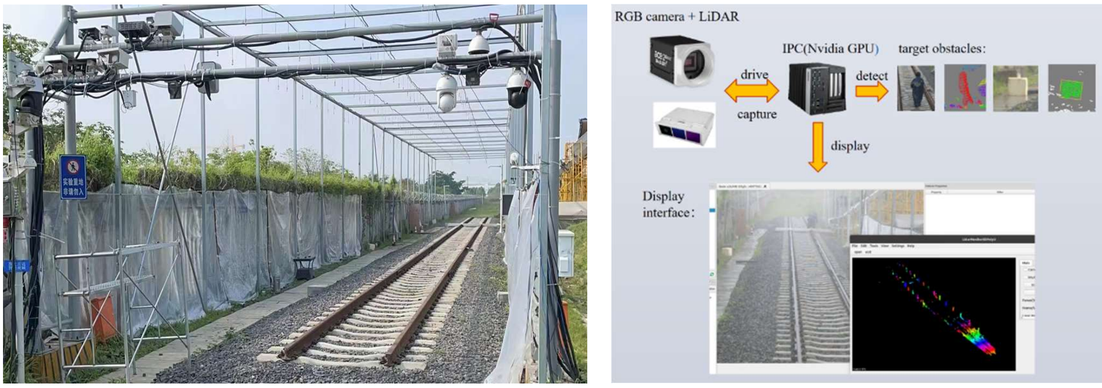


Fig. 2.12 On-site installation and testing of obstacle intrusion detection system

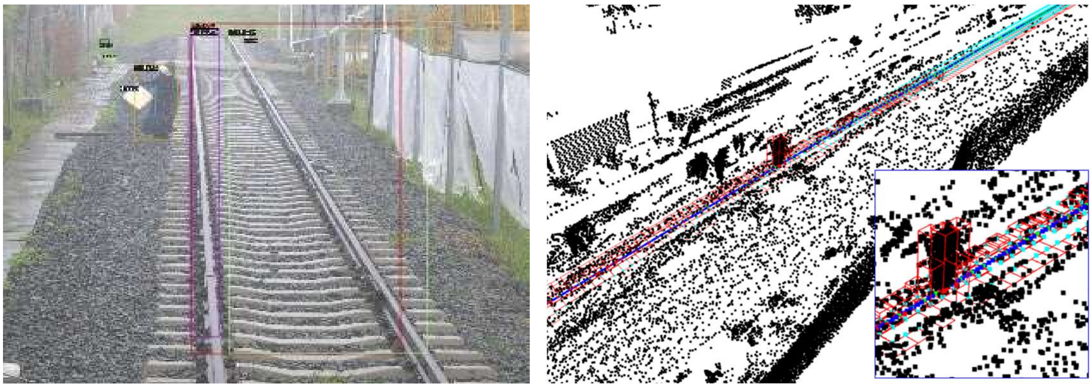


Fig. 2.13 Obstacle detection results based on images and point clouds

2.2.7 Research on The Large Model of Maglev Knowledge Question and Answer (Q&A)

Traditional approaches for evaluating the condition of railway components have demonstrated effectiveness in predicting their status, primarily categorizing them as either normal or abnormal. However, these methods offer limited insight into the specific condition or root cause of abnormalities and often fail to provide a comprehensive explanation of the overall system state. With recent advancements in multimodal feature learning techniques, the integration of visual and textual data has become feasible, enabling a broader range of downstream applications, such as visual question answering.

This study investigates the condition of maglev track joints and the performance of the suspension control system. The visual Q&A model is designed to extract detailed insights from data, synthesizing evidence of damage and faults by leveraging accumulated prior knowledge. The dataset is structured as an image-question-answer triplet, where the image is derived from a time-frequency spectrogram, and the corresponding questions and answers are formulated based on the intrinsic structural dynamic characteristics of the maglev system, as illustrated in

Fig. 2.14. The findings indicate that the proposed model enhances semantic interaction between visual and textual data, demonstrating high reliability in both response accuracy and expression quality. Additionally, it significantly improves the automation of damage and fault detection, contributing to a more intelligent railway infrastructure monitoring system and facilitating informed decision-making, thereby enhancing the safety and efficiency of railway operations.

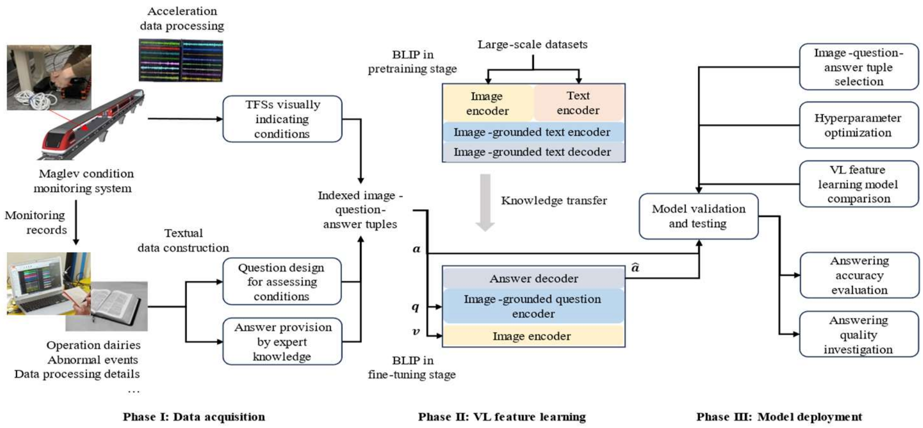


Fig. 2.14 Maglev knowledge Q&A large model technology flow

2.2.8 Deep Reinforcement Learning-Based Control Study of Maglev System

As a cutting-edge mode of transportation, maglev trains are frequently subjected to external disturbances and track irregularities during operation. These challenges not only compromise the stability and reliability of the maglev system but may also lead to suspension point failures, posing risks to safe train operations. To enhance the system's resilience to environmental factors, this study introduces a suspension controller based on deep reinforcement learning (DRL). Additionally, the research accounts for the nonlinear characteristics of the maglev system, the coupling perturbation effect between levitation points, the vehicle-rail coupling model, and the safety control problem.

(1) Adaptive nonlinear levitation control of maglev trains using deep reinforcement learning with transfer learning

This study seeks to address the challenges posed by external disturbances and track irregularities affecting maglev trains during long-term operation. To enhance the system's robustness against environmental factors, a suspension/levitation controller was designed using a deep reinforcement learning approach incorporating transfer learning. As part of the research, wind tunnel experiments were conducted to measure the external wind forces acting on the maglev train during operation. The impact of these forces on the maglev train and its coupling with the flexible track system under deep reinforcement learning control was then analysed. This study offers novel insights and methodologies for achieving adaptive nonlinear suspension control in maglev train systems.

(2) Adaptive multi-intelligence reinforcement learning cooperative control based on nonlinear levitation system

This study examines the nonlinear characteristics of the maglev levitation system, and the coupling disturbance effects between levitation points. To mitigate their impact on system stability and reliability, a multi-agent deep reinforcement learning approach is employed to develop a collaborative controller for two suspension points, as shown in Fig. 2.15. This controller enables adaptive adjustments to the suspension system's control strategy while effectively minimizing coupling disturbance effects. The findings contribute to a novel solution for enhancing collaborative control in maglev systems.

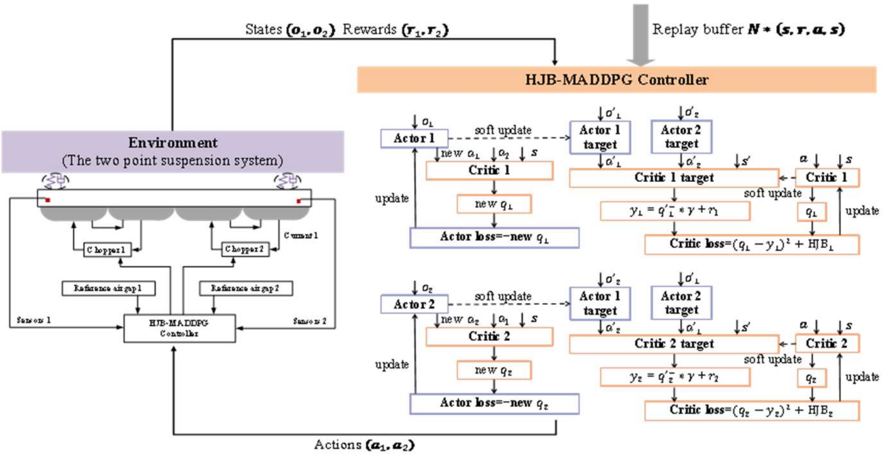


Fig. 2.15 Multi-intelligent body deep reinforcement learning method flow

(3) Control method of magnetic levitation train and flexible rail track coupling system based on interactive control barrier function and deep reinforcement learning controller

To address the control challenges of the coupled system comprising a maglev train and a flexible track, this study proposes a deep reinforcement learning controller integrated with an interactive control barrier function. By incorporating the interactive control barrier function, the method enhances system safety and stability, while the deep reinforcement learning algorithm optimizes the control strategy. The proposed approach was validated on a maglev system, with results demonstrating its effectiveness in controlling the coupled maglev train–flexible track system. This study presents a novel technical approach for ensuring the safe operation of maglev systems.

(4) Investigating the effect of external wind on the maglev system controlled by a deep reinforcement learning controller

This study examines the effects of external wind on a maglev system regulated by a deep reinforcement learning controller. Ms. Qi Zhu, a researcher at CNERC-Rail (HK Branch), conducted simulation experiments and data analysis, as shown in Fig. 2.16. The research provides a comprehensive investigation into the influence of external wind on the system's stability and control strategies. The findings contribute to a deeper understanding of the maglev system's dynamic behaviour and control mechanisms while offering essential theoretical insights and practical guidance for enhancing its operational stability and reliability.

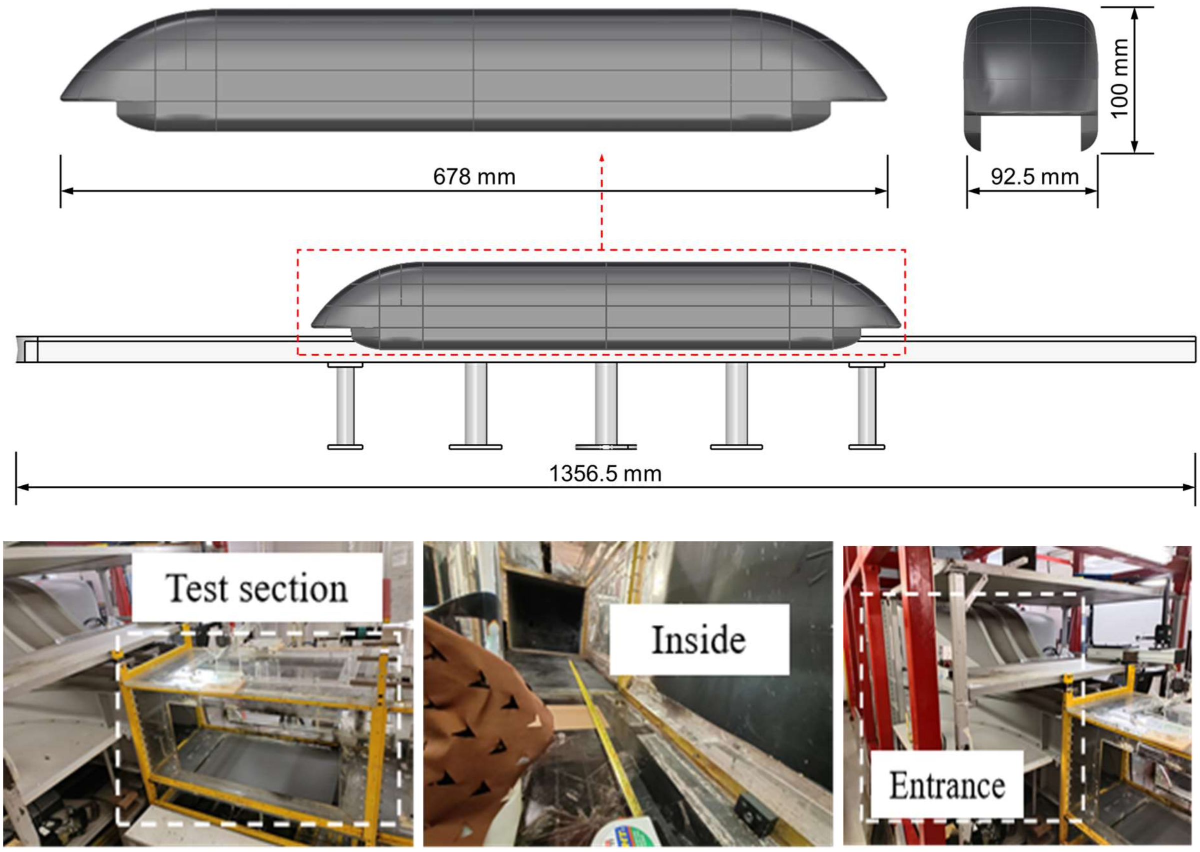


Fig. 2.16 Experiments on the effect of external wind on the stability and control strategy of maglev systems

In conclusion, the proposed maglev system control approach, based on deep reinforcement learning, offers an effective solution for enhancing the stability and reliability of maglev trains. By accounting for key factors such as the system's nonlinear characteristics, coupling disturbances between levitation points, and external influences, this study significantly improves the system's robustness while ensuring the safe operation of maglev trains.

Furthermore, it provides valuable theoretical foundations and practical insights to support future research and advancements in maglev technology.

2.2.9 Modelling of High-Speed Maglev Trains and Wheel-Rail Dynamics

Dr. Yun-Fan Yang, a member of the CNERC-Rail (HK Branch), developed a high-speed maglev train-rail spatial coupling dynamics model based on the vehicle-rail coupling dynamics theory. The dynamics modelling meticulously considers the vehicle suspension structure, levitation control system, and rail components, which provides the basis for the refined simulation of high-speed maglev system dynamics, as shown in Fig. 2.17.

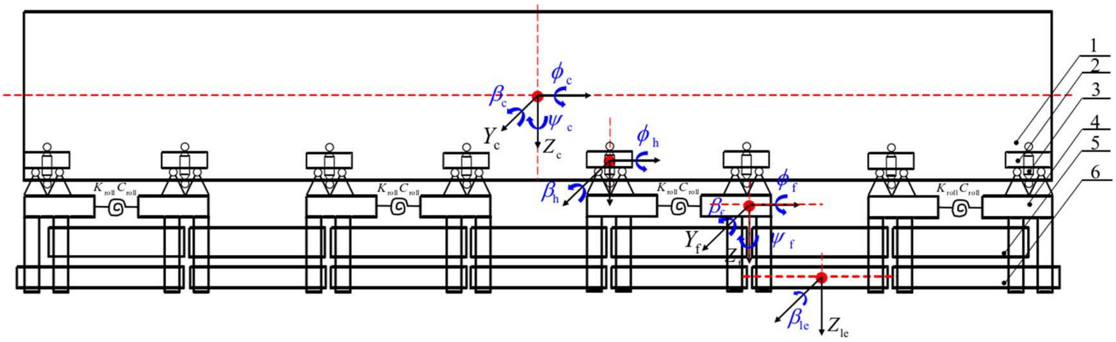


Fig. 2.17 High-speed maglev train-track spatial coupling dynamics modelling

Additionally, the explicit finite element method is employed to develop a three-dimensional transient rolling contact model of the wheel-rail system, as illustrated in Fig. 2.18. This model facilitates the analysis of transient rolling contact phenomena in high-speed railway systems and can be further utilized to investigate the influence mechanisms of various rail fastener types on the progression of rail corrugation wear.

Fig. 2.18 Three-dimensional wheel-rail transient rolling contact modelling

2.2.10 A Bridge Collision Prevention System Incorporating Multi-Source Data from Video and AIS

With the increasing density of modern water traffic, bridges, as critical transportation infrastructure, face significant risks of ship collisions. Incidents such as the ship collision at

Guangzhou Lixinsha Bridge have resulted in severe casualties and substantial property damage. Developing proactive bridge collision warning systems and identifying potential collision risks are essential for enhancing bridge safety. However, relying solely on a single data source, such as video or AIS, is insufficient for obtaining comprehensive ship information in the vicinity of bridges. Furthermore, the diversity of vessel types and varying visibility under different weather conditions present considerable challenges for effective ship tracking and monitoring.

To overcome the limitations of existing technologies, the CNERC-Rail (HK Branch), in collaboration with the Shenzhen Institute of Disaster Prevention and Mitigation Technology (SIDMT), launched a research project titled “Key Technology for Active Early Warning and Emergency Response of Bridge Anti-Vessel Collision Based on Multi-source Sensing and Artificial Intelligence Algorithm”. In the initial phase of the project, Dr. Jun-Ping Zhong, Dr. Wen-Qiang Liu and Dr. Su-Mei Wang investigated intelligent algorithms for ship tracking in waters near bridges by integrating two perception sources: video and AIS data.

(1) Integration of video and AIS multi-source data for target ship tracking

As shown in Fig. 2.19, the YOLOv10 deep learning model is employed for real-time ship detection in video footage, enabling the extraction of each ship's trajectory within the video coordinate system. Simultaneously, to associate AIS data with the detected ships, a projection model is developed to map the world coordinate system to the video coordinate system. This process aligns AIS data with the image coordinate system, generating a visual representation of AIS trajectories. By comparing the similarity between video-based and AIS-derived trajectories, real-time ship tracking is achieved through the integration of video and geographic information.

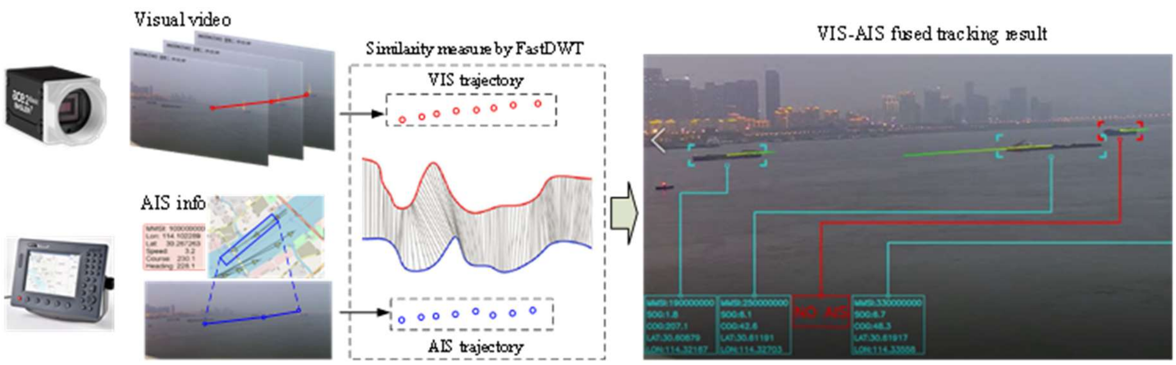


Fig. 2.19 Workflow of the bridge collision prevention system integrating video and AIS multi-source data

(2) Enhanced ship tracking in adverse weather conditions, including rain and fog

Considering that adverse weather conditions, such as rain and fog, impair the visibility of ship targets and subsequently affect the effectiveness of video-based ship tracking, this study proposes the application of the OneRestore deep learning model to enhance images affected by rain and fog. This enhancement improves the visibility of ships in videos, thereby enhancing the accuracy of ship tracking under such weather conditions. YOLOv10 is employed to perform visual tracking on both the enhanced and original images, with a comparative analysis of the changes in the ship's trajectory. The results demonstrate an improvement in the accuracy of the ship's trajectory after the application of the OneRestore enhancement, as shown in Fig. 2.20.

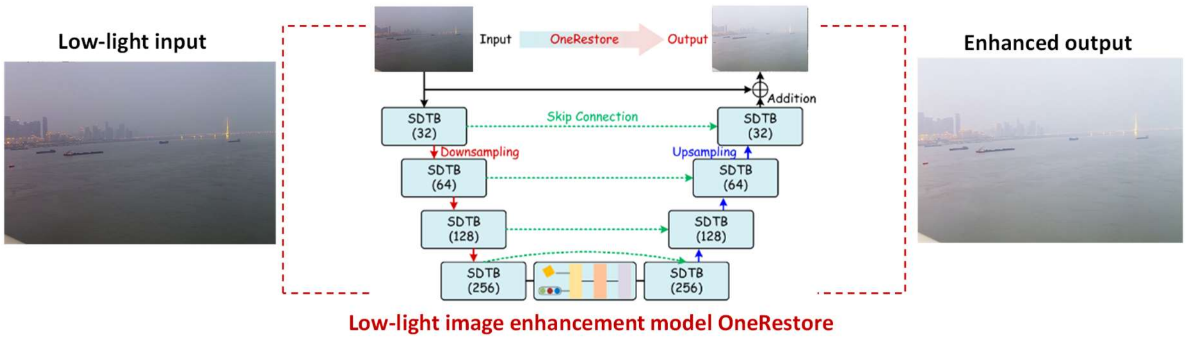


Fig. 2.20 Processing of low-light images under dark weather conditions

2.2.11 Inspection of Latent Defects in The Tunnel Structure at The Wuchang Vehicle Base of Hangzhou Metro Line 5

In August 2024, Dr. Si-Yi. Chen and Mr. Huai-Yuan Zhou from the CNERC-Rail (HK Branch) conducted a study on the detection of latent defects in the tunnel structures at the Wuchang vehicle base of Hangzhou Metro Line 5, as shown in Fig. 2.21. The test site comprises the ground-level track section, including a 100 m ballasted track segment and a 300 m ballastless track segment, a 50 m shield tunnel section, and a station section, utilizing a ground-assembled tunnel structure.

To address the technical challenges of low efficiency and difficulty in identifying hidden defects in subway tunnels, this research has developed an innovative automated detection system. The system integrates a fully automated inspection trolley with a dual-channel ground-penetrating radar (GPR) antenna, capturing radar signals at intervals of 0.02 m (with a time window length of 40 ns and 1024 sampling points) through a range-measuring wheel trigger. Longitudinal measurement lines are arranged at the spandrel, waist, and arch bottom, enabling high-efficiency scanning of the tunnel structure.

The four-day testing process followed a structured and systematic schedule. On the first day, the test vehicle's mileage was measured, and the radar system was calibrated. The second day was dedicated to comprehensive tunnel scanning, with a particular focus on detecting two common structural issues: roadbed voids and water-filled cavities behind the lining wall. On the third day, data processing was conducted, accompanied by a visit to PolyU-Hangzhou Technology and Innovation Research Institute. Finally, on the fourth day, on-site verification of questionable data was performed, followed by comparative analysis and evaluation.

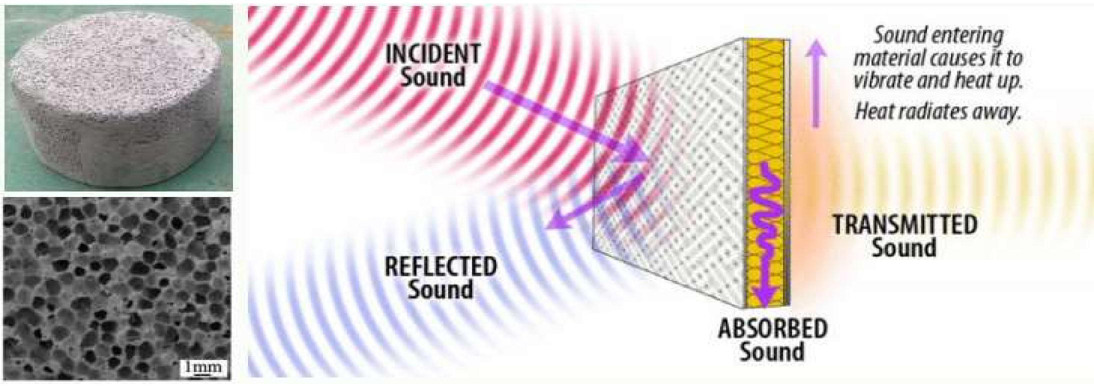
Fig. 2.21 Schematic diagram of on-site test equipment and work area

This research has yielded several significant findings. High-quality radar images of roadbed voids and water-filled cavities behind lining walls were successfully obtained, providing valuable data for training deep learning networks. Additionally, a systematic evaluation was conducted on the influence of tunnel surface interference factors—such as electrical boxes, pipelines, and steel reinforcements-on the accuracy of ground-penetrating radar detection, laying the foundation for further algorithm optimization. Furthermore, the reliability of the automated detection system was validated in real engineering environments, demonstrating an approximately 60 % increase in detection efficiency compared to traditional methods.

This study introduces an innovative technical approach for monitoring the structural health of subway tunnels, playing a crucial role in enhancing the safety of rail transit operations. The findings can be directly applied to routine inspections and maintenance decision-making for subway tunnels, serving as a valuable reference for the intelligent operation and maintenance of urban rail transit infrastructure

2.2.12 Research on Noise-Absorbing Foam Concrete and Its Near-Track Rail Noise Absorber for Urban Rail Transit

Aiming at the vibration and noise control requirements of urban rail transit, this study developed a sound-absorbing foam concrete and a near-track rail noise absorber system utilizing recycled solid waste. By integrating recycled micropowder from construction waste with waste polystyrene foam (EPS), a lightweight, low-carbon material with adjustable density was produced, offering both high sound absorption (average absorption coefficient of 0.55 in the 500-1000 Hz range) and waterproof properties. The innovative material design incorporates a composite structure of a microporous plate, porous material, and cavity layer, achieving acoustic impedance matching through a foam concrete lining. This configuration effectively mitigates noise within the primary frequency range of urban rail transit (800-1600 Hz). Laboratory tests indicate that the equivalent sound pressure level of near-track noise is reduced by 1.2 dB, while the maximum sound pressure level is decreased by 1.9 dB.



(a)

(b)

Fig. 2.22 Design and application of foam concrete rail noise absorbers: (a) design principles; (b) field test applications

As shown in Fig. 2.22, the proposed rail noise absorber system overcomes the limitations associated with traditional metal sound-absorbing panels, which are prone to corrosion, and rock wool materials, which suffer from poor durability. By optimizing the pore structure, the system effectively dissipates sound wave energy through air friction while also providing impact resistance and pressure buffering capabilities. With a solid waste content exceeding 60% and a production cost approximately 35% lower than conventional sound barriers, this system offers a sustainable and cost-effective solution for near-field noise reduction in urban rail transit.

2.2.13 Test of Performance Enhancement in Railway Rubber Rail Pads

Railway rubber rail pads are essential components of the railway system, primarily designed to mitigate vibrations and noise generated during train operations while protecting the structural integrity of both tracks and rolling stock. Enhancing the mechanical properties of rubber rail pads, particularly the dynamic-to-static stiffness ratio, is crucial for optimizing overall railway system performance. This ratio serves as a key metric for evaluating the pad’s response under both dynamic and static loads. An optimal dynamic-to-static stiffness ratio effectively absorbs impact forces during train movement, minimizes wear on tracks and trains, and ensures adequate support for stable train operation. Enhancing this property not only extends the lifespan of railway infrastructure but also improves passenger comfort and operational safety. Furthermore, optimized rail pads contribute to reduced maintenance costs and enhanced railway efficiency. Therefore, investigating and refining the dynamic-to-static stiffness ratio of rubber rail pads is of significant importance for the sustainable advancement of modern railway systems.

In December 2024, Mr. Qi-Fan Zhou, a member of the CNERC-Rail (HK Branch), conducted experiments at Dongdian Rubber Company in Sanmen County, Zhejiang Province, to enhance the performance of rubber rail pads. The study focused on three key approaches: modifying the existing material formulation, incorporating a fiber reinforcement layer, and optimizing the vulcanization process. First, adjustments to the rubber formulation aimed to enhance the material's fundamental mechanical properties, improving its performance under both dynamic and static loads. Second, the introduction of a fiber reinforcement layer was intended to strengthen the structural integrity and durability of the pad. Given their exceptional tensile strength and toughness, fiber materials effectively increase the pad's load-bearing capacity and resistance to fatigue. Finally, optimizing the vulcanization process was crucial to achieving optimal physical properties in the rubber. By precisely regulating vulcanization temperature and duration, the elasticity and wear resistance of the material were enhanced, ultimately extending the pad's service life. These three strategies were designed to work synergistically to comprehensively improve the performance of rubber rail pads, ensuring they meet the efficiency and reliability demands of modern railway systems. Through these advancements, the pads achieved improved dynamic-to-static stiffness ratios and enhanced overall mechanical properties.

Fig. 2.23 Railway rubber rail pads

2.2.14 Research on Broadband Noise Reduction in Rail Transit Using Bionic Acoustic Metamaterials Assisted by Machine Learning

Under the background of accelerated new urbanization, urban rail transit system is facing the double contradiction of proliferation of operation mileage and lagging behind of noise pollution control. The traditional vertical short walls and sound barriers are limited by the Helmholtz resonance principle and the physical properties of porous acoustic materials, and they generally have the inherent problems of bulky structure and narrow absorption band when dealing with the main frequency band of wheel-rail noise from 500 to 2000 Hz. In this study, we break through the limitations of the constitutive relationship of traditional acoustic materials and propose a multilayer honeycomb-rib composite acoustic metamaterial architecture inspired by the subtle acoustic structures formed by biological evolution. The design integrates the Helmholtz resonance mechanism of honeycomb cavities with the gradient impedance matching property of multi-perforated plates and achieves broadband acoustic energy capture and dissipation at sub-wavelength scales through biomimetic topology optimization. A multidimensional design space containing four geometrical parameters (honeycomb aperture d, cavity depth h, etc.) is constructed, and a nonlinear prediction model of sound absorption coefficients is established using a modified Kolmogorov-Arnold network. Particularly noteworthy is the physical constraint layer embedded in the network architecture, which effectively improves the generalization ability of the model in the unsteady acoustic field by coupling the elastic fluctuation equation with the acoustic impedance boundary condition. Together with the particle swarm optimization algorithm with adaptive inertia weights, the breakthrough of the average sound absorption coefficient $\alpha \geq 0.8$ in the 500-2000 Hz frequency band under the condition of 0.8λ ultra-thin thickness (λ is the wavelength of 2000 Hz) is successfully achieved, which is an enhancement of 26.5 % compared with that of the traditional glass wool material, and the optimized acoustic metamaterial model is shown in Fig. 2.24.

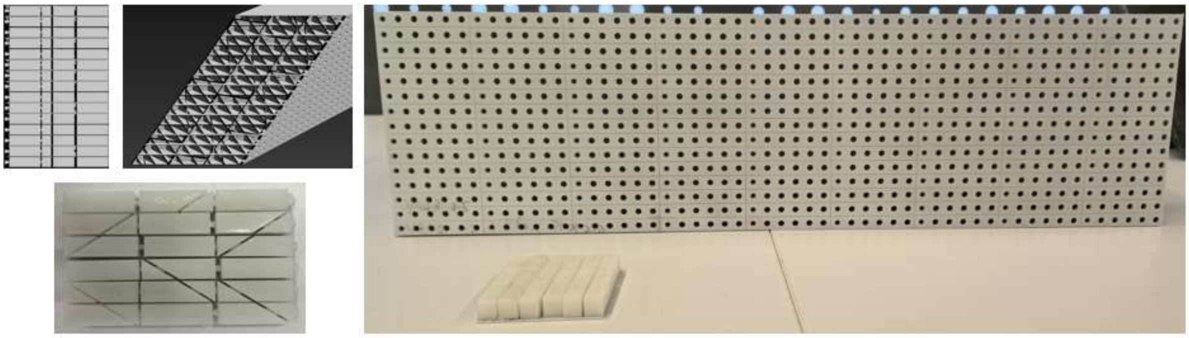


Fig. 2.24 Machine learning-assisted optimization of acoustic metamaterials

2.2.15 Long-Term Performance Monitoring of Lightweight Concrete Slabs in Modular Integrated Construction (MiC)

On March 26, 2024, Dr. Su-Mei Wang, Dr. Si-Qi Ding, Dr. Chao Yang, Mr. Guang Zhou, and Mr. Ying-Nan Hu from the CNERC-Rail (HK Branch) conducted an experiment at the Jiangmen China Resources ZhiZhu Factory. Their objective was to install sensors in the lightweight concrete floor of a modular integrated construction (MiC) unit, as shown in Fig. 2.25, to monitor the long-term shrinkage behaviour of lightweight concrete. The sensor arrangement included six vibrating wire strain gauges, four self-sensing concrete strain sensors, and four resistance strain gauges, strategically placed at the mid-span and both ends of the structure. The experimental process comprised five key steps: (1) assembling the steel reinforcement cage, (2) installing the sensors, (3) pouring the lightweight concrete, (4) connecting data acquisition equipment, and (5) initiating real-time monitoring.

The test crews of the CNERC-Rail (HK Branch) connected the sensors to the corresponding data acquisition system, conducted system debugging, and verified the accuracy of the collected data. Following this, the lightweight concrete floor slab and data acquisition system were transported to the CIMC MiC factory, where the segmented floor slabs were integrated with the steel module frame to form a complete MiC unit. This unit was then transported to Hong Kong for installation and operational use. The installed sensors will enable long-term monitoring of the floor slab's performance, providing essential data to support the application of lightweight concrete in MiC floor systems. Additionally, the installation and commissioning of the on-site monitoring system were conducted in Yuen Long, Hong Kong, as shown in Fig. 2.26.

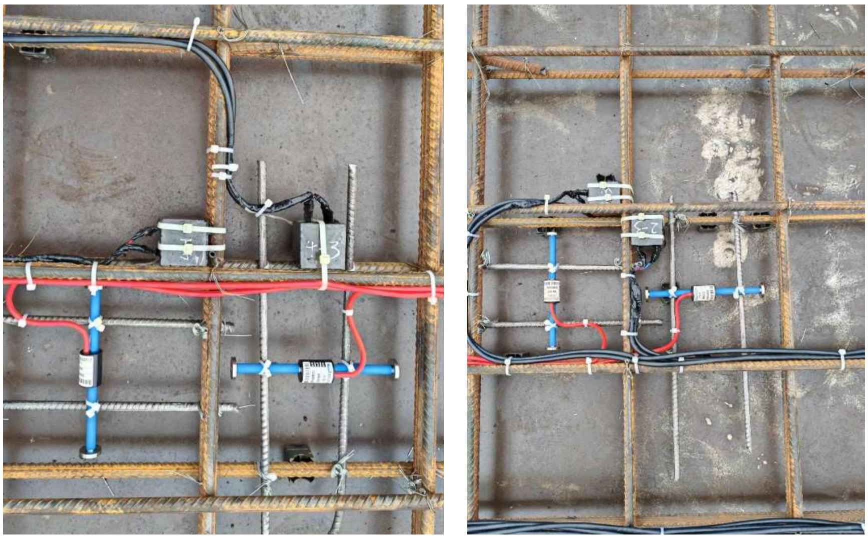


Fig. 2.25 Sensor arrangement schematic diagram

Fig. 2.26 Deployment and calibration of the on-site monitoring system in Yuen Long, Hong Kong

2.2.16 A Study on Time Series Forecasting Based on Continuous Time State Space Neural Network (CSNN)

The aim of this study is to address the problem of constructing alternative models for force-vibration systems using continuous time state space neural networks (CSNN). The model takes time series as inputs and outputs and focuses specifically on the case where energy dissipating devices (EDDs, such as bearings or dampers) are installed in the structure. Traditional physical modelling methods may be both difficult and inaccurate for EDDs, while constructing a neural network model for the entire structure is inefficient and fails when the structure undergoes changes. Therefore, this study proposes an approach that combines CSNN modelling and physical modelling to predict the response of the structure more efficiently, as shown in Fig. 2.27.

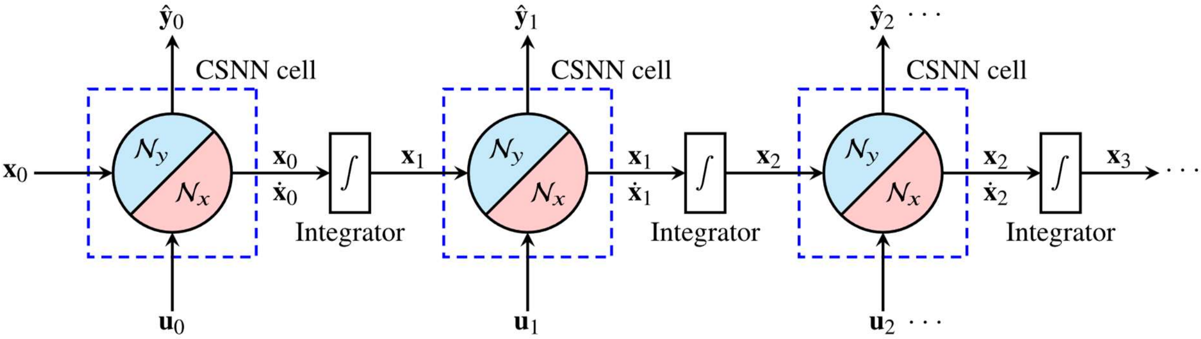


Fig. 2.27 Continuous time state space neural network (CSNN) key architecture

(1) Modelling framework and methodology

The study introduces the hidden state x(t) and constructs two neural networks Nx and Ny (referred to as the state calculator and the output calculator, respectively) as shown in Fig. 2.28. Both networks take the hidden state and the system inputs at the current time step as inputs to compute the derivatives of the states and predict the outputs, respectively. For the structure with EDDs installed, the study constructed a CSNN model for it, while a physical model was constructed for the main structure without EDDs installed and coupled them in state space. This approach allows us to model and predict the dynamic response of the structure more accurately.

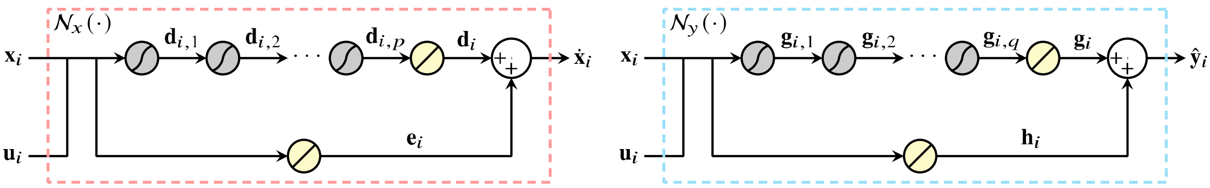
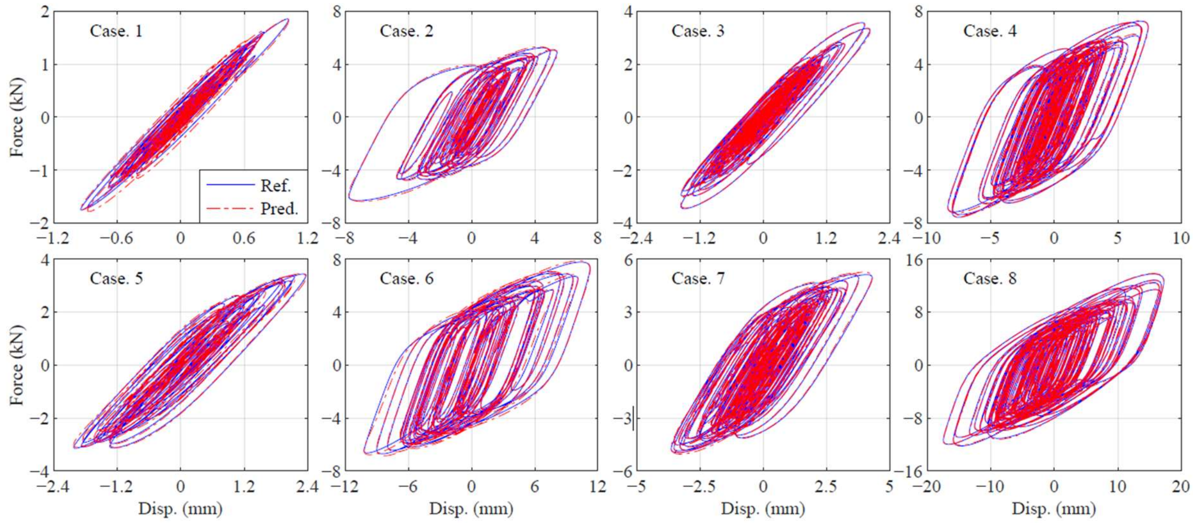


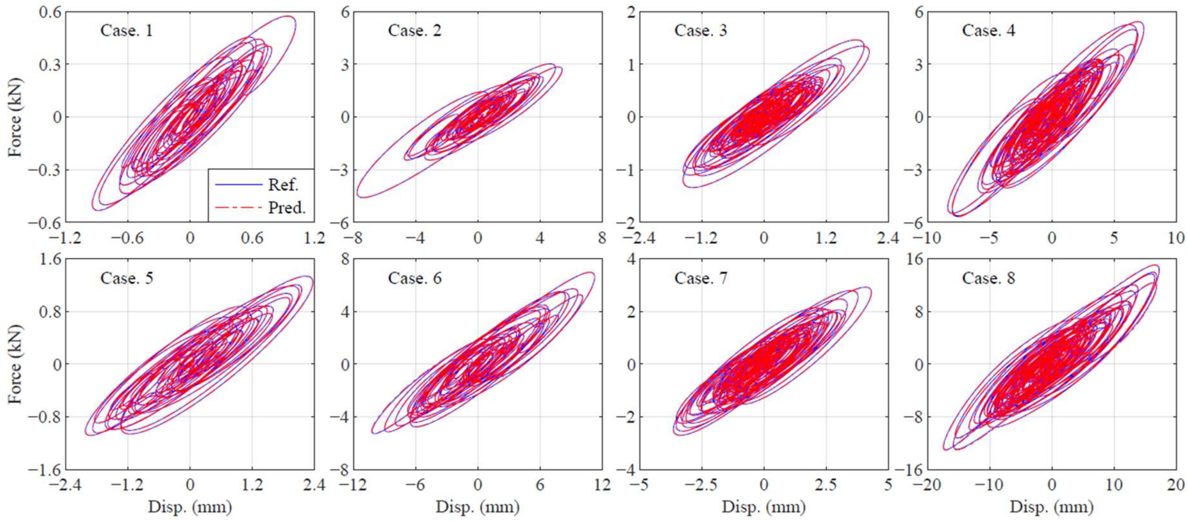
Fig. 2.28 Status calculator and output calculator

(2) Numerical examples and experimental results

The study first demonstrated a structural frame with dampers installed and simulated it using the CSNN model. Through the Simulink program, the study compared the structural response predicted by the model with the structural response under real seismic data (e.g., Kobe earthquake). The results show that the CSNN model can accurately predict the dynamic response of the structure under seismic action. Further, the study demonstrated a structural frame with bearings mounted and simulated using the CSNN model as well. The accuracy of the CSNN model was again verified by comparing the model predictions with the structural response under real seismic data (e.g., Jiji earthquake). In addition, the study demonstrated the free field effect (FFE) and seismic isolation scheme of the structure to further illustrate the potential of the CSNN model for practical engineering applications, as shown in Fig. 2.29.



(a)



(b)

Fig. 2.29 Experiment result: (a) ground truth; (b) predictions

The results show that this study has successfully solved the challenge of modelling force-vibration systems by constructing an alternative model based on CSNN. Both numerical examples and experimental results show that the CSNN model can accurately predict the response of the structure under dynamic loads such as earthquakes. Future research can further explore the application of the CSNN model in other engineering fields and how the prediction accuracy and efficiency can be improved by optimizing the model structure and parameters.

2.2.17 Application of Physical Information-Based Neural Networks in Solving Time-Averaged Flow Fields Around Buildings and High-Speed Trains

As an alternative approach to computational fluid dynamics, the concept of neural networks embedded with physical information (PINN) has been proposed and attracted much attention in recent years. By embedding physical governing equations, initial and boundary conditions, and residuals of measured data into a loss function, PINN has been shown to be a reliable physics-based data-driven method for solving various partial differential equation problems. In this study, fluid velocity data obtained from wind tunnel tests will be utilized to train and validate the PINN model for building wind simulation as shown in Fig. 2.30.

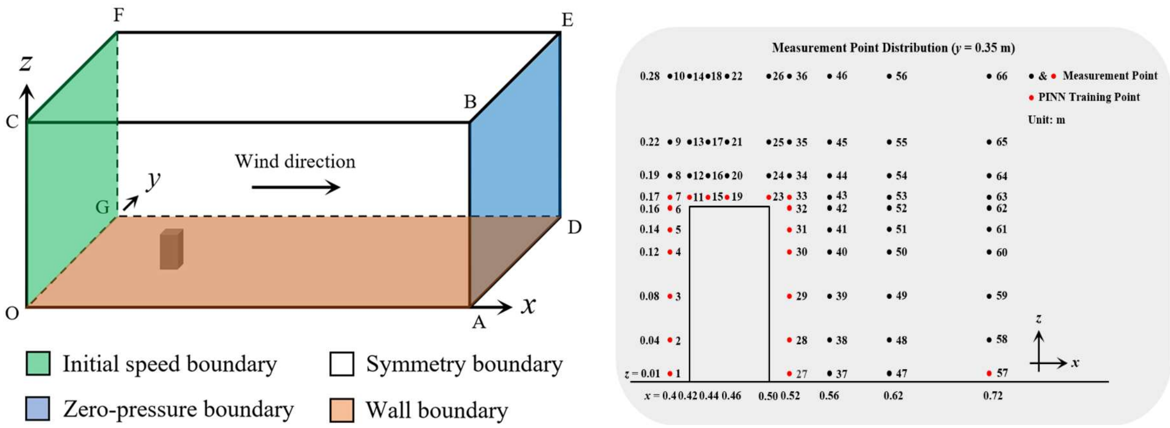


Fig. 2.30 Computational domain, boundary conditions and measurement point information for wind tunnel tests

By embedding the physical equations and measurements into the neural network, it is possible to reconstruct the missing airflow information throughout the computational domain, as shown in Fig. 2.31.

The flow field around a high-speed train operating in a crosswind environment will be complex, especially on the leeward side. In order to obtain the details of the flow field around the train in a crosswind environment, computational fluid dynamics is used in this study to simulate the time-averaged flow field around a high-speed train. In addition, the velocity and pressure flow field information in three regions, namely, the near-train surface region, the near-train region, and the far-train region, are extracted point by point from the simulation results and embedded in the PINN framework of the physical control equations. The results show that although only 1.5 % of the flow field information (i.e., u, v, and p) is sparsely embedded in the neural network to reconstruct the flow field around a high-speed train in a crosswind environment, the PINN is still able to simulate the flow field around the train with relatively high accuracy due to the help of the physical governing equations, as shown in Fig. 2.32.

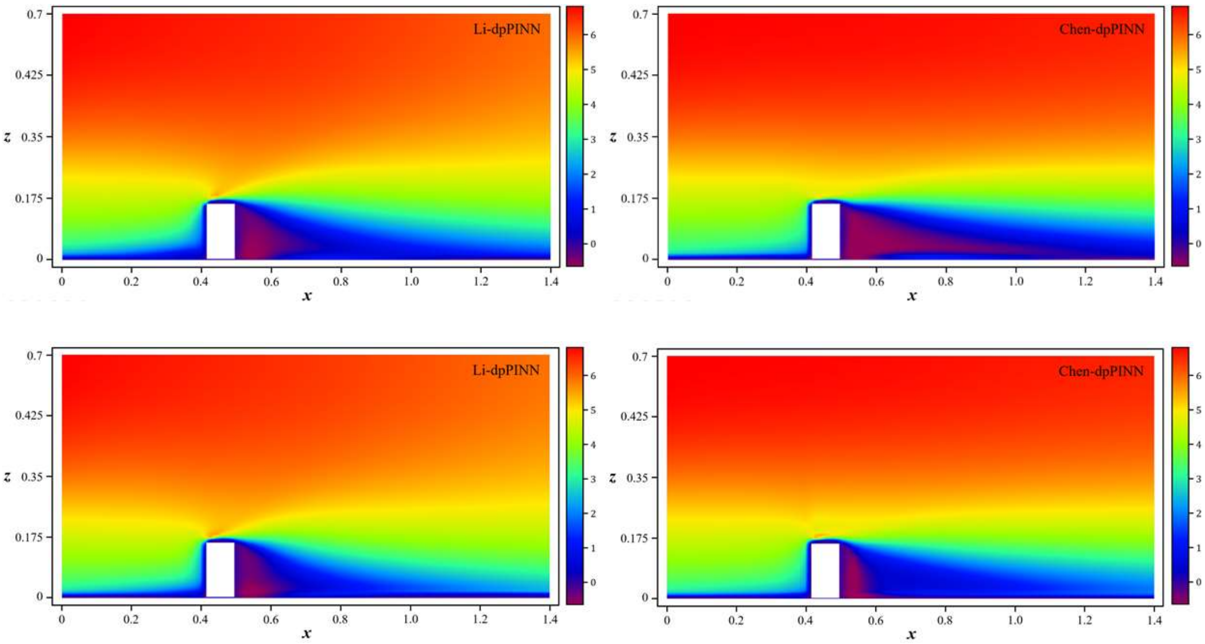


Fig. 2.31 PINN wind field simulation results

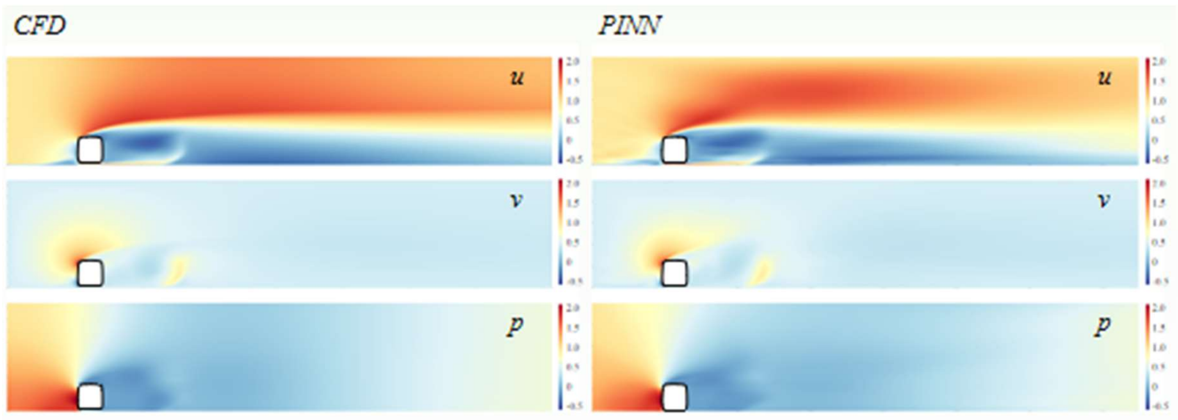


Fig. 2.32 Comparative results of CFD and PINN in wind field reconstruction

2.2.18 Optimization of Crosswind Aerodynamic Performance of High-Speed Train Based on Active Blowing and Suction Method

The sensitivity of the train crosswind aerodynamic characteristics to the velocity at the blowing/suction boundary was investigated under the condition that the entire train wall was set as the blowing/suction boundary. The initial study adopted a simplified strategy based on past experience, i.e., a slotted blow/suction device was set up in the region around the separation vortex shedding point on the leeward side of the head car, as shown in Fig. 2.33, and was limited to the uniform blow/suction method. Through a careful analysis of the relationship between the blowing/suction boundary velocity and the train crosswind aerodynamic characteristics, the reasonableness of the current blowing/suction boundary position and velocity setting is clarified, and the possibility of further optimization is explored.

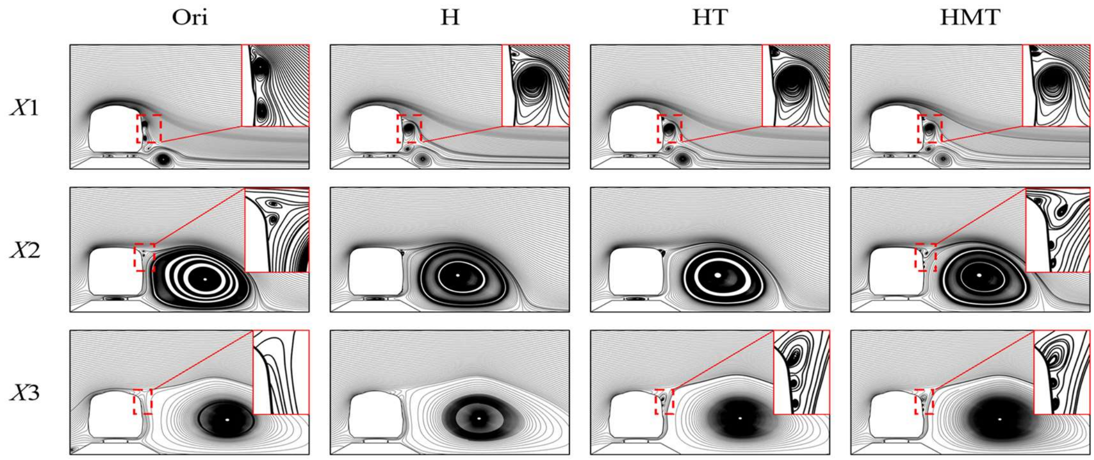


Fig. 2.33 Effect of blow/suction position on the flow field around the train in a crosswind environment

Under the condition of open line, it is verified that the blowing/suction method can effectively alleviate the crosswind pressure on the train. Subsequently, the study was extended to a variety of line scenarios, such as tunnels, bridges, road riffles and embankments, to investigate the effect of the blowing/suction technique on the aerodynamic characteristics of the train's crosswinds under different line environments, and to clarify the applicability of the technique under different line scenarios, as shown in Fig. 2.34.

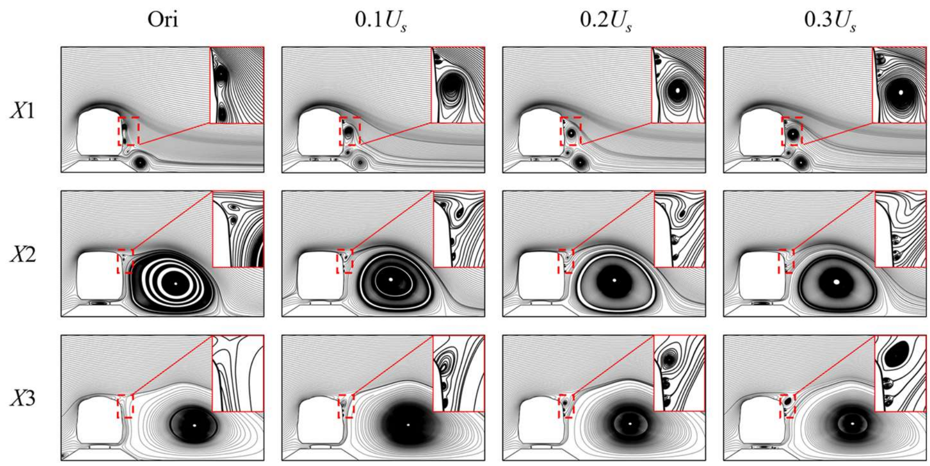


Fig. 2.34 Effect of blowing/suction velocity on the flow field around the train in a crosswind environment

Based on the "Provisional Technical Conditions for 350 km/h China Standard Rolling Stock", the study firstly selected the most representative crosswind limiting conditions (train speed of 200 km/h, wind speed of 25 m/s, and wind direction of 90° crosswind) as the benchmark, and verified the effectiveness of the blowing/absorbing strategy under these conditions, as shown in Figure 2.35. Subsequently, the study was further extended to the different combinations of wind speeds, wind directions, and speeds to further analyse the effect of the blowing/absorbing technique on crosswind aerodynamic characteristics of the train, as shown in Fig. 2.35. The effects of the blowing/suction technique on the aerodynamic characteristics of the train crosswind are analysed in depth.

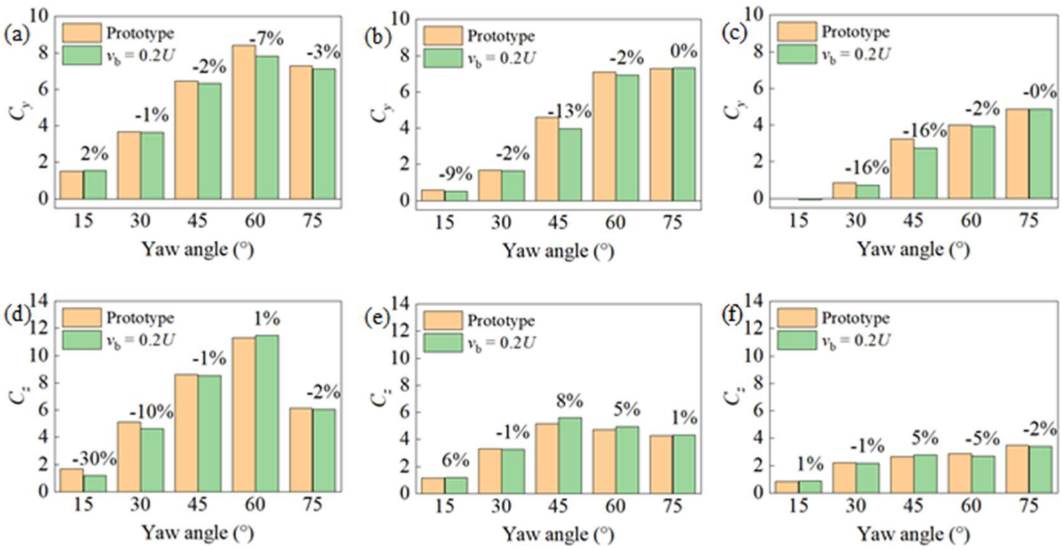


Fig. 2.35 Effect of blowing/suction strategy on train aerodynamic characteristics under different wind angles

2.2.19 Theoretical Study of High-Speed Train Aerodynamic Noise Calculation

Dr. Xiao-Ming Tan from the CNERC-Rail (HK Branch) established the near-field aerodynamic noise calculation theory for trains below 350 km/h based on the acoustic potential fluctuation equation and sponge layer sound-absorbing boundary, as shown in Fig. 2.36, and successfully debugged the coefficients applicable to the theory with engineering application value, e.g., the largest aerodynamic noise source in the bogie region was found as shown in Fig. 2.36, and the focus is to manage the aerodynamic noise of bogie crossbeam and cylinder region.

In addition, Dr. Tan constructed a theoretical system of radiated noise correction for aerodynamic acoustic principal mode correlation in bow-cavity coupled systems: due to the limitations of acoustic wind tunnel size and computational scale/precision, the aerodynamic noise of high-speed trains is usually investigated by using a reduced-ratio vehicle body model.

However, due to the complexity and diversity of aerodynamic sound bodies, it is difficult to give a consistent scale similarity law. Based on the aeroacoustic similarity parameters in the self-modelling region (including the Mach number Ma, the Strahl number St, and the dimensionless sound source parameters), combined with the theory of sound power computation for unipolar, dipolar, and quadrupolar sound sources, the aerodynamic noise conversion relations for different scale models can be simply established. This is the current general practice for solving such problems. However, they do not take into account the flow field morphology migration effect caused by the change of Reynolds number, the field coupling effect caused by the change of spatial distance of different components, and the change of incoming boundary layer parameters. To address the above scientific issues, a fine aeroacoustic simulation technique for a full-size bow-cavity coupled system is developed and improved, and the dominant flow modes and their scale evolution mechanisms in the region are obtained by a data-driven approach, and the acoustic similarity law of the dominant aeroacoustic modes is obtained by combining the aeroacoustic theory of cavities/rods. Then, a radiated noise correction model associated with the dominant aerosound modes is constructed, which can be used to correct the scaled model test or numerical simulation results.

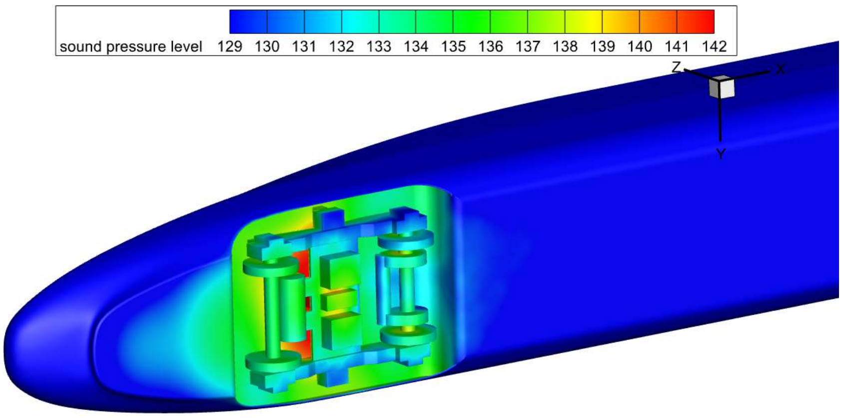


Fig. 2.36 Schematic diagram of near-field aerodynamic noise calculation for trains under 350km/h

2.2.20 Development of Deep Learning-Based Models for Track and Intensity Predictions and Wind Field Reconstruction of Tropical Cyclone

A novel approach, the physics-informed graph neural network (PIGNN), has been introduced to enhance the reconstruction of wind fields from sparse data. By integrating the strengths of physics-informed neural networks (PINNs) with the information aggregation capabilities of graph neural networks (GNNs), PIGNN demonstrates improved performance over conventional PINNs. Results indicate that this integration is feasible and effective for reconstructing tropical cyclone wind fields, paving the way for more accurate railway-related risk assessments.

The application of three Transformer-based models—vanilla Transformer, inverted Transformer (iTransformer), and temporal-variate Transformer (TVFormer)—for short-term TC track and intensity predictions is explored. A comparative analysis with two recurrent neural network (RNN) models reveals that Transformer-based models generally outperform RNN-based models, achieving mean absolute error (MAE) reductions of 14.10% to 41.05% for track predictions and 6.92% to 20.51% for intensity predictions over a 24-hour period. Among the Transformer-based models, iTransformer demonstrates superior performance in track predictions. Conversely, TVFormer excels in intensity predictions. The exploration of Transformer-based models in predicting TC track and intensity paves the way for early warning systems to ensure railway operation safety.

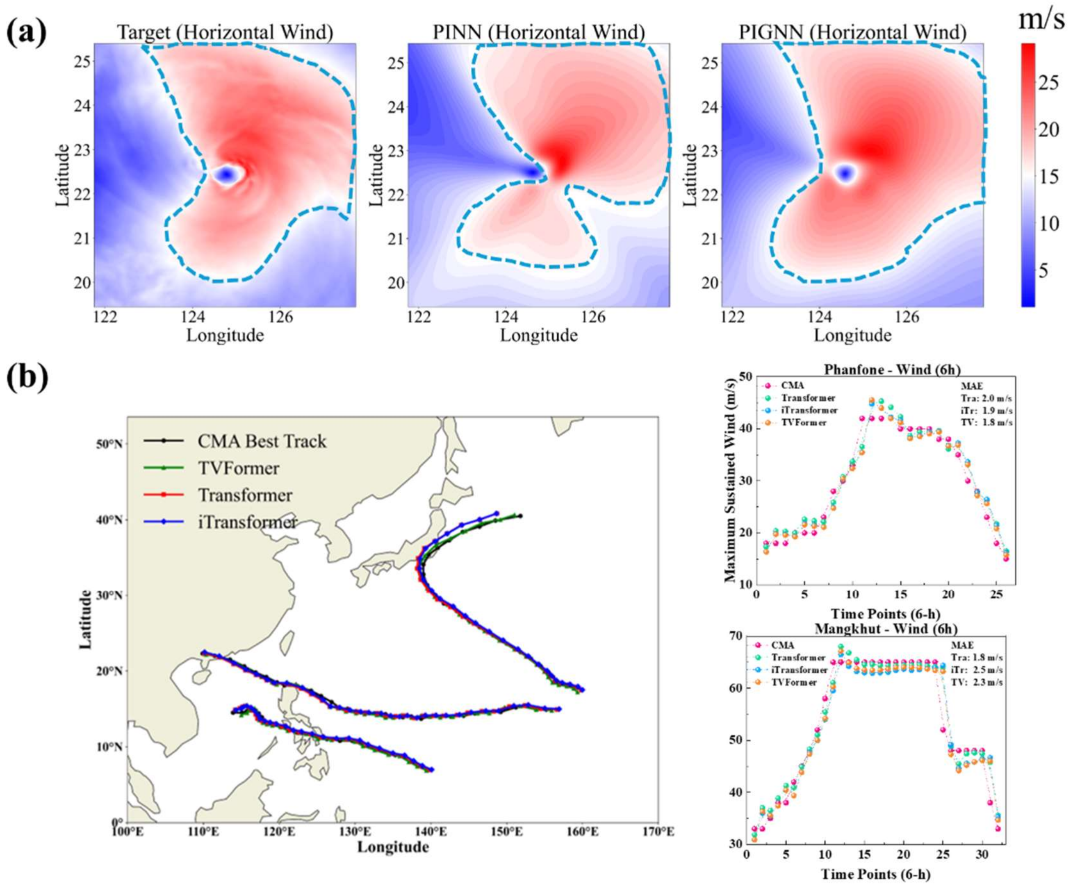


Fig. 2.37 Wind field reconstruction and typhoon track and intensity prediction

2.2.21 Modelling of Multi-Scale Urban Wind Field in Typhoon Environment

Based on the weather research and forecasting (WRF) model, a multi-scale numerical simulation of the 2018 super typhoon Mangosteen is carried out in this study, as shown in Fig. 2.38, with the aim of reproducing the development and evolution of the typhoon during its approach to Hong Kong, as well as its impacts on the urban wind field. The simulation period covers the whole process from the typhoon's entry into Hong Kong within 800 km to its landfall and dissipation. The results show that the simulated path agrees well with the observation data from the Hong Kong Observatory (HKO), with an average path deviation of only 29.19 km. Meanwhile, the simulated typhoon intensity results also show high agreement with the measured data, in which the average deviations of the typhoon centre pressure and maximum wind speed are controlled within 10.56 hPa and 6.90 m/s, respectively.

Based on the dynamical downscaling method, the study further simulates the urban wind field characteristics under the influence of super typhoon Mangosteen. By adopting high-resolution topography and land use datasets and combining them with an urban canopy model, a refined simulation of a realistic scenario of a coastal city under a typhoon environment is realized. Comparison with the observed data from meteorological stations in the built-up area shows that the difference between the simulated wind speed and the measured value is small, which fully verifies the reliability of the multiscale modelling method in reproducing the urban wind field characteristics during the typhoon transit. The results of the multiscale modelling of typhoon environment obtained in this study can provide important decision support for disaster prevention, safety assessment, and operation and maintenance of railroad systems.

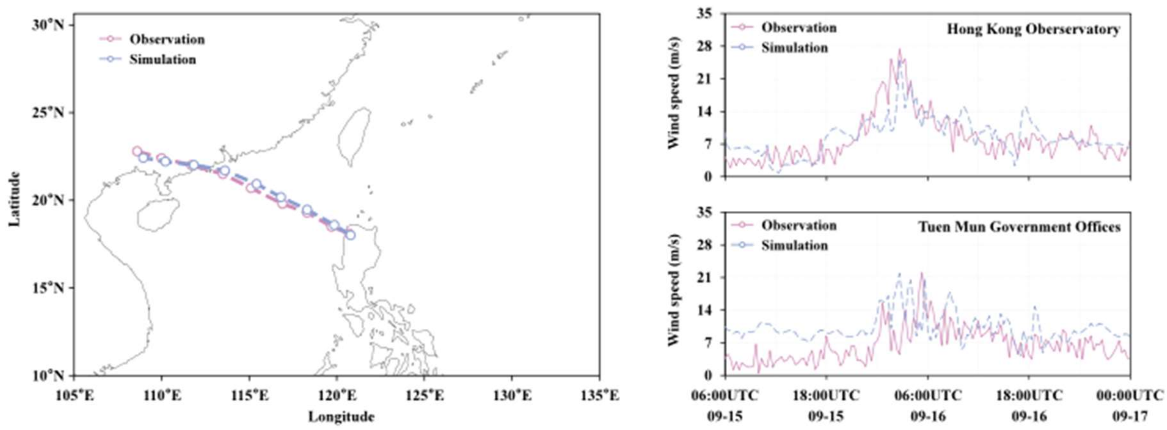


Fig. 2.38 Modelling of multi-scale urban wind field in typhoon environment

2.2.22 Lidar-Based Wind-Rain Synchronized Observation System

(1) Territory-wide LIDAR monitoring network system

Based on the results of a comprehensive site selection survey across Hong Kong, members of the CNERC-Rail (HK Branch), including Dr. E Deng, Dr. Yue Dong, Dr. Xiu-Yu Chen, scientifically selected seven strategic observation sites (see Fig. 2.39). In July 2024, the research team completed the installation and calibration of all LiDAR equipment and officially launched the territory-wide LiDAR monitoring network system on August 6, 2024.

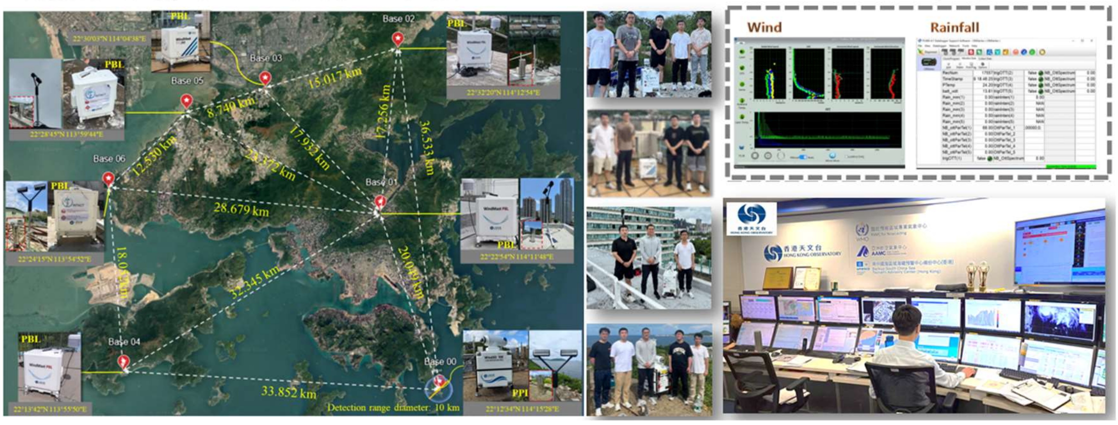


Fig. 2.39 Lidar and laser raindrop spectrometer measurement point distribution and application diagrams

The system consists of five planetary boundary layers (PBL) LiDAR units and one 3D scanning LiDAR (Wind3D 10K model), forming a 36×36 km synchronous observation network. Among these, the Base 00 site is equipped with the Wind3D 10K radar, while the remaining sites utilize PBL-type radars, with each unit covering an average range of approximately 15 km, enabling real-time monitoring of the wind field across Hong Kong. The PBL LiDAR is responsible for measuring vertical wind profile variations, while the 3D LiDAR employs the PPI scanning mode to analyse the three-dimensional structure of the wind field.

Currently, the system has been handed over to the Hong Kong Observatory for operational use, successfully completing full process monitoring and early warning during the impacts of Typhoons "Yagi" and "Toraji." The monitoring network integrates LiDAR and laser raindrop spectrometers, providing critical technical support for meteorological disaster prevention.

(2) Typhoon Monitoring System for Li Ka Shing Building at The Hong Kong Polytechnic University

Dr. E Deng, Dr. Yue Dong and other researchers from the CNERC-Rail (HK Branch) conducted a multi-dimensional study on the wind environment of the main building of The

Hong Kong Polytechnic University campus, with a focus on the Li Ka Shing Building. The study adopts a comprehensive research method combining CFD numerical simulation, on-site measurement and wind tunnel test, of which the on-site measurement program is designed as follows (see Fig. 2.40).

Fig. 2.40 Diagram of typhoon monitoring system equipment and site installation at Li Ka Shing Building at The Hong Kong Polytechnic University

Wind pressure and wind speed sensor arrays were installed at key locations on the roof and facade of the Li Ka Shing Building, along with a LiDAR system for wind profile measurements. Specific implementations include installing a reference target on the 18th-floor platform, deploying wind pressure sensor groups and data acquisition boxes, and configuring precision measurement equipment such as ultrasonic anemometers. To ensure continuous operation of the monitoring system, solar panels were installed as an auxiliary power supply, and cameras 1 and 2 were deployed to record equipment operating status and environmental changes. Through multi-source data fusion, this study aims to establish a wind field database for the campus building cluster, providing scientific evidence for urban building wind environment assessment. The research team pays special attention to the interaction between wind field characteristics and building layouts, focusing on analysing wind field distribution patterns under typical meteorological conditions.

2.2.23 LiDAR Network Observation of Typhoon Yagi

On the evening of September 1, 2024, typhoon Yagi formed over the waters east of the Philippines and made landfall on Luzon Island on the afternoon of September 2, 2024. It then entered the South China Sea and rapidly intensified, reaching a peak intensity of 68 m/s as announced by the China Meteorological Administration on the morning of September 6, 2024.

From the afternoon to the evening of the same day, the typhoon made landfall successively along the coasts of Wengtian Town in Wenchang, Hainan (62 m/s), and Jiaowei Township in Xuwen, Guangdong (58 m/s). After entering the Gulf of Tonkin, the typhoon maintained its intensity and made another landfall along the southern coast of Quang Ninh Province, Vietnam, on the afternoon of September 7 (58 m/s). It gradually weakened and finally dissipated on the afternoon of September 8, 2024. Fig. 2.41 shows the track and statistical data of Yagi. On the evening of September 5, 2024, the typhoon passed through the South China Sea at its closest distance of 340 km from Hong Kong. During this period, the CNERC-Rail (HK Branch) utilized the LiDAR network system to monitor the boundary layer wind field characteristics of the typhoon.

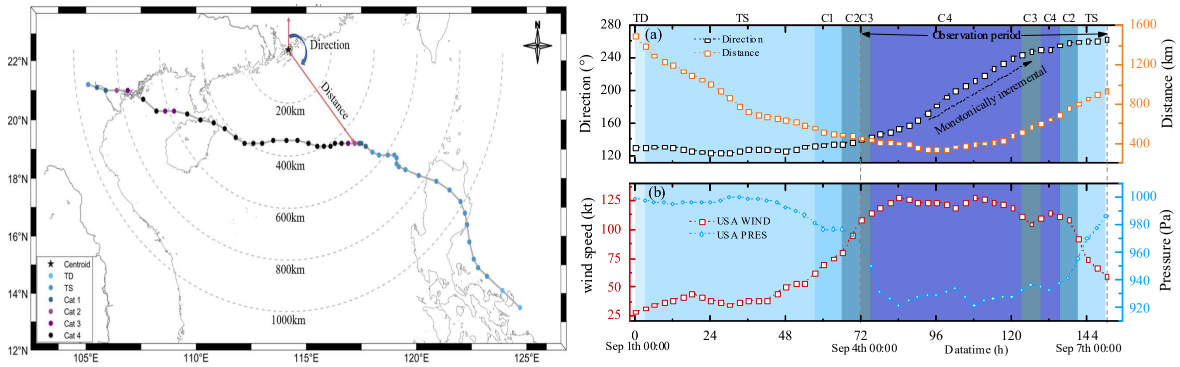


Fig. 2.41 Track and statistical data of Yagi

As shown in Fig. 2.42, the spatiotemporal distribution characteristics of wind speed and direction at different heights across five stations during the typhoon are represented by colour intensity, reflecting the magnitude of the values. The data indicates that wind speeds were relatively low before the typhoon's arrival, with wind directions showing significant disorder. During the 12 hours period from 20:00 on September 5, 2024, to 08:00 on September 6, 2024, when the typhoon was closest to Hong Kong, the wind field distribution exhibited a notable strengthening trend and reached its peak. Wind directions at each observation point stabilized around specific values during this period.

To gain a deeper understanding of the structure and characteristics of the typhoon boundary layer, we extracted and analysed the wind profiles at the peak wind speed moments. The results show that at the Base CHPS site (see Fig. 2.43), the peak wind speed was accompanied by intense turbulent fluctuations. Due to the site's location in an urban area with dense high-rise buildings, the wind direction varied significantly with height. In contrast, at other sites with flat terrain and no high-rise obstructions, the wind direction exhibited a clear monotonic increase with height. This finding provides important empirical data for studying the impact of urban topography on typhoon wind fields.

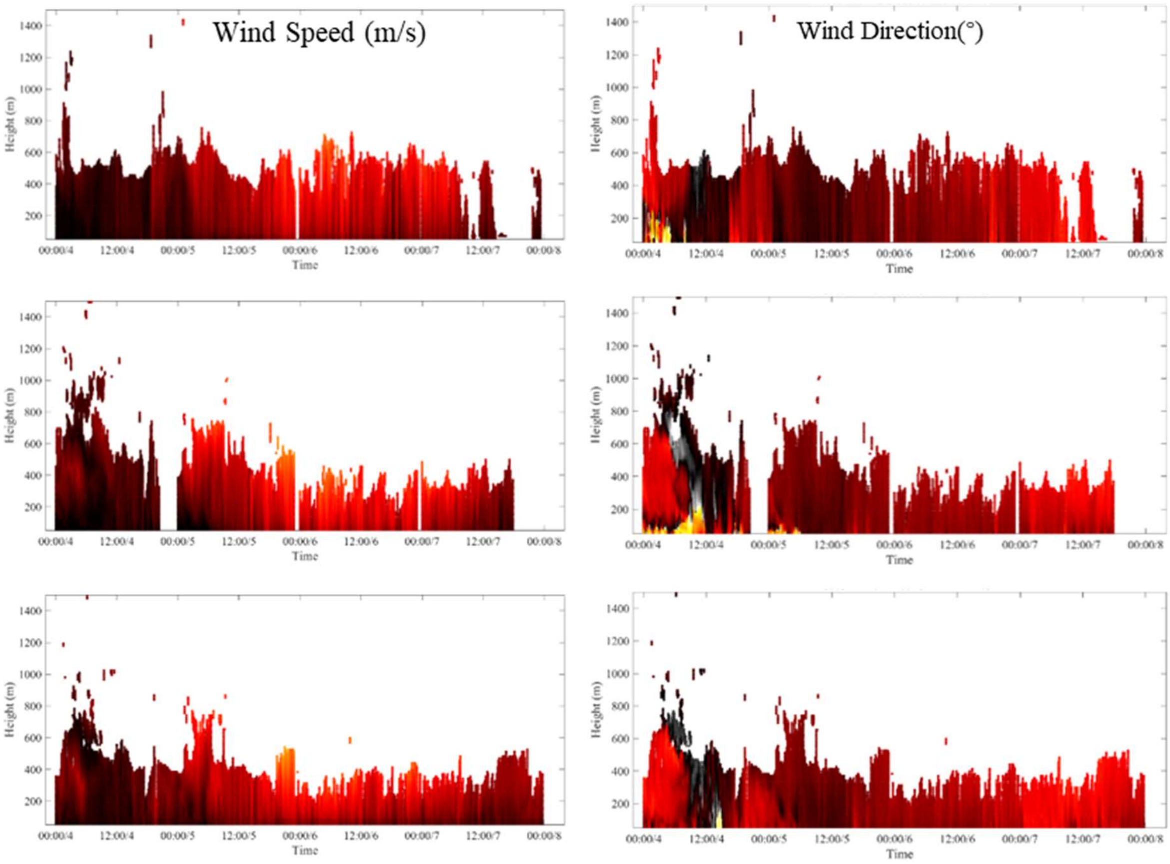


Fig. 2.42 Contour plots of wind speed and direction at different heights

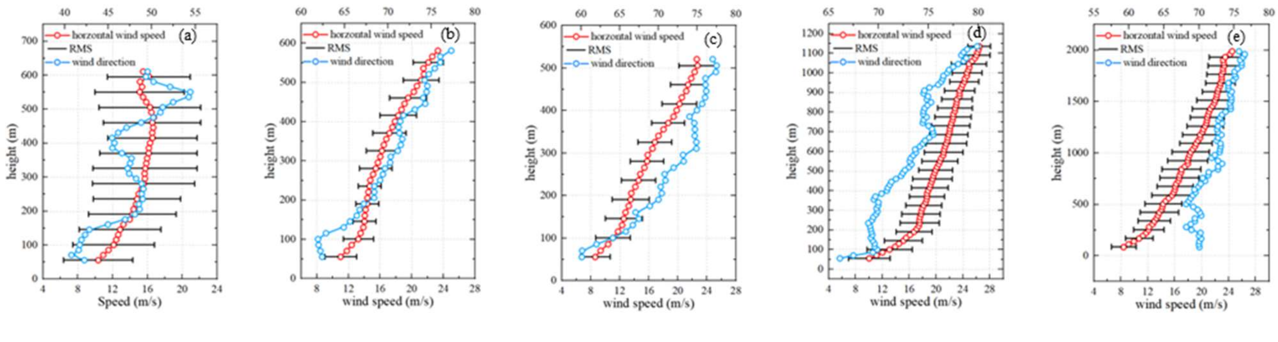
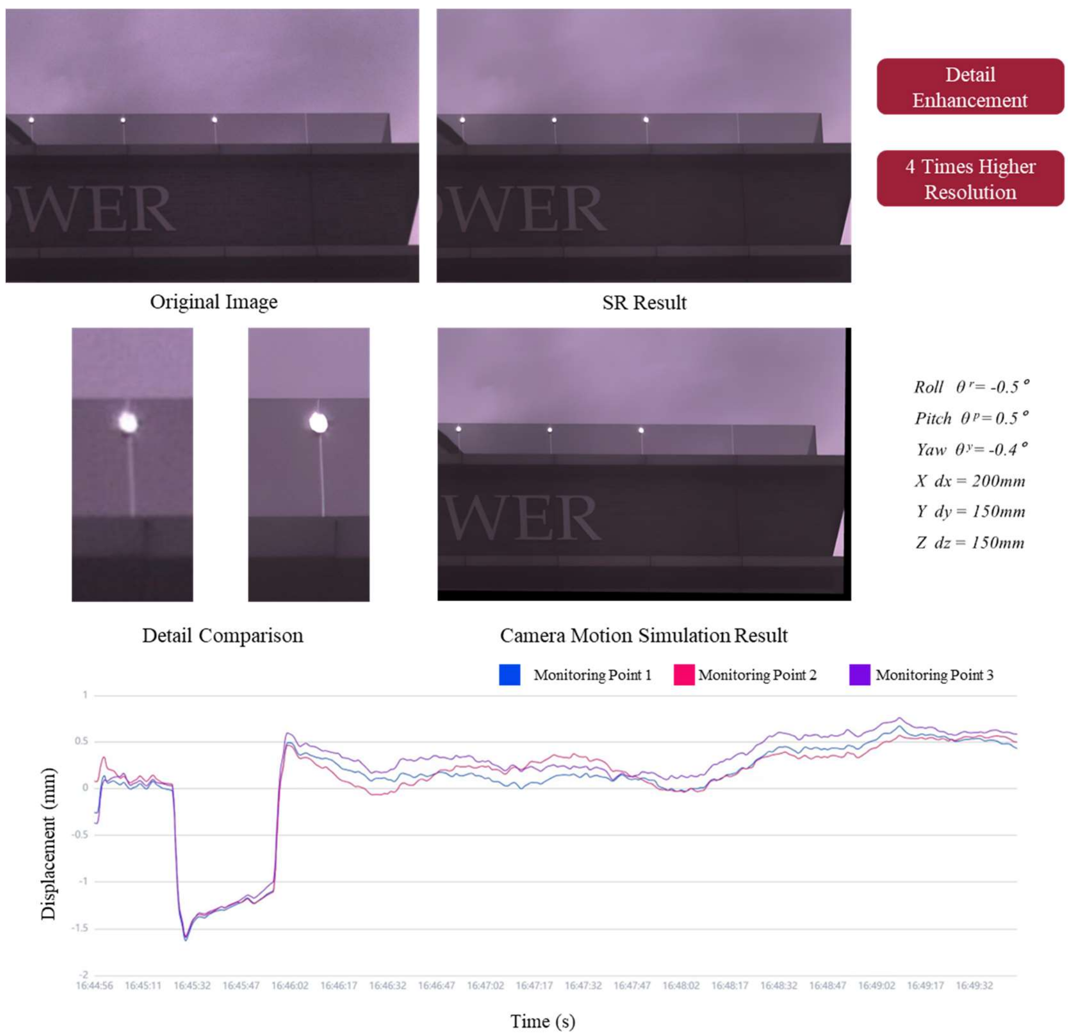


Fig. 2.43 Wind profile distribution diagram at peak time

2.2.24 Real-Time Monitoring, Wind Tunnel Testing, and Numerical Simulation-Based Analysis of Wind Loads and Responses on Building (Clusters)

(1) Real-Time Monitoring of Building Displacement Based on Inertial-Vision Measurement System

A high-precision target displacement measurement method integrating deep learning and inertial sensing is proposed. In terms of image processing, a super-resolution enhancement algorithm based on generative adversarial networks (GAN) is innovatively adopted. By constructing a dense residual convolution (RDB) network architecture and combining transfer learning strategies, the image resolution and detail texture features are effectively enhanced, laying a data foundation for subsequent sub-pixel-level target displacement calculation. In terms of motion compensation, a camera displacement correction algorithm based on inertial data is developed. By integrating an inertial measurement unit (IMU), the three-axis attitude angles (roll, pitch, yaw) and displacement data of the camera platform are obtained in real-time, and a pixel-level displacement error correction model is constructed to compensate for system errors introduced by camera motion. Experiments show that this method improves the target displacement measurement accuracy to below 0.1 pixels, providing reliable technical support for fields such as structural health monitoring.



Note: The U-shaped displacement change in the short term is caused by errors in the imaging path.

Fig. 2.44 Millimeter-level real-time dynamic monitoring

(2) Calculation and evaluation of structural response of Hong Kong Waterfront Plaza under typhoon

The wind environment study of Hong Kong’s Waterfront Plaza adopts a comprehensive research approach combining multi-scale wind tunnel tests and numerical simulations. The research team from the CNERC-Rail (HK Branch) conducted wind tunnel tests at two scale ratios of 1:250 and 1:1000, systematically obtaining the distribution characteristics of wind speed and pressure fields around buildings. Based on the experimental data, the research focuses on two innovative directions: firstly, the innovative application of physics-informed neural networks (PINN) for intelligent analysis of wind tunnel data, achieving high-precision wind pressure prediction and three-dimensional wind field reconstruction under single test conditions, significantly improving data utilization efficiency; secondly, through comparative analysis of WRF large eddy simulation (LES) and wind tunnel test data, the reliability of numerical simulations was verified, and a "wind tunnel-LES" data fusion model was established, providing a high-precision prediction tool for urban wind environment assessment. This research not only provides a scientific basis for the wind environment optimization design of the Waterfront Plaza and its surrounding areas but also promotes the integrated development of experimental and numerical methods in the field of wind engineering. The research findings have broad application values in areas such as urban building cluster wind load assessment and pedestrian wind environment optimization.

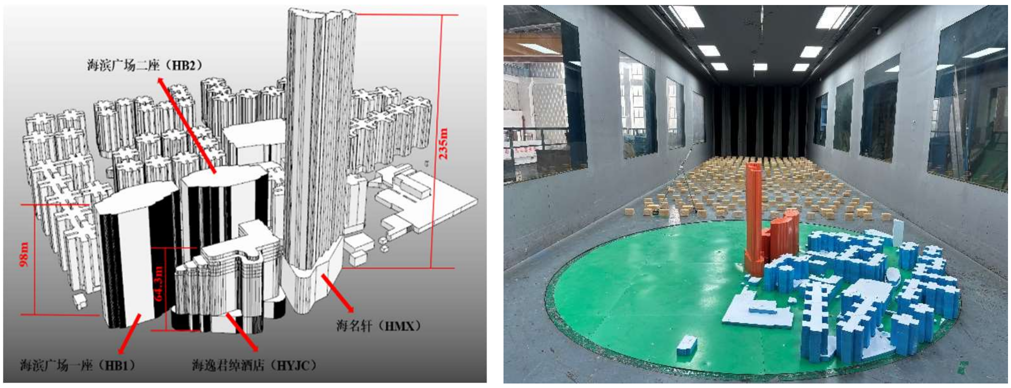


Fig. 2.45 Wind tunnel test of Hong Kong Waterfront Plaza structure under typhoon

(3) Hong Kong’s historical architectural evolution model

The research team from the CNERC-Rail (HK Branch) has innovatively constructed a CFD-deep learning fusion model aimed at optimizing the wind environment of urban building clusters. The study employs a multi-scale modelling approach, initially generating a large-scale dataset of building flow fields through traditional CFD simulations and then utilizing deep learning models (including convolutional neural networks (CNN) and graph convolutional networks (GCN)) to extract flow characteristics and pressure distribution patterns from the CFD outputs. To enhance the model's generalization capability, the research introduces generative adversarial network (GAN) technology, generating diverse wind field samples under different historical building layout conditions through data augmentation strategies, effectively addressing the issue of insufficient training data.

Based on the model, the research team has developed an integrated decision support system capable of providing scientific building layout recommendations for urban planners. The system quantifies the fluid dynamic impacts of new constructions on the surrounding environment, proposing optimization strategies to minimize the wind environmental effects on existing buildings while enhancing the overall ventilation performance of the area. Research results indicate that the model can accurately predict the wind field distribution of building clusters, offering significant technical support for urban sustainable development. This innovative approach combines traditional fluid mechanics with modern artificial intelligence, opening new pathways for urban wind environment research.

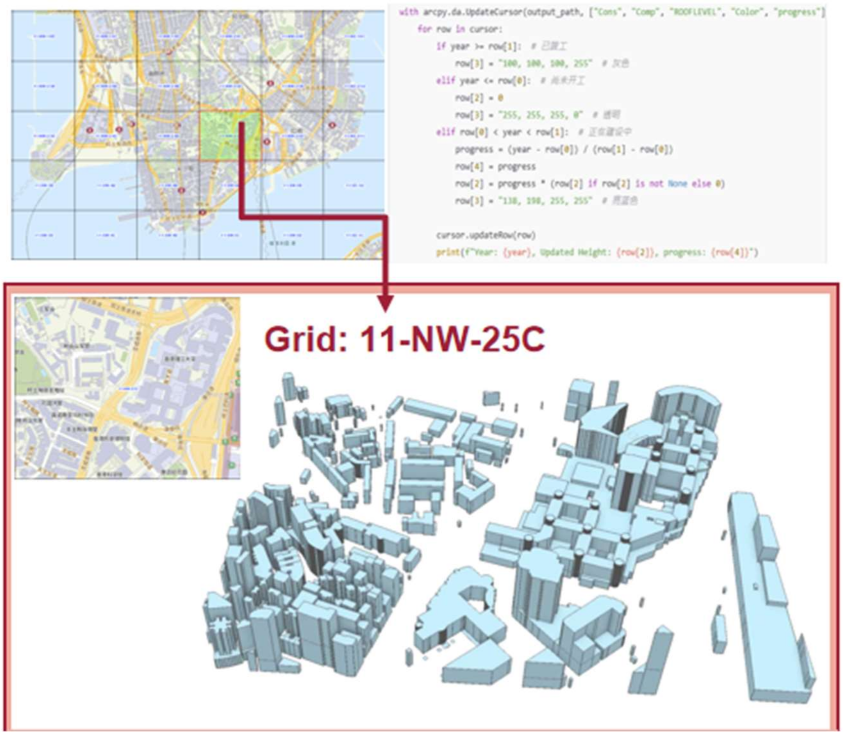


Fig. 2.46 11-NW-25C historical evolution of building heights in the grid area

2.2.25 Hardware Prototype for The Edge-Cloud Collaborative Railway Monitoring Platform

Since July 2022, Prof. Jiannong Cao's team has been addressing the challenges of real-time railway condition monitoring. They have embarked on developing a hardware prototype for an edge-cloud collaborative railway monitoring platform, as shown in Fig. 2.47. Their approach involves leveraging cutting-edge hardware components and integrating them into a cohesive system specifically tailored for railway monitoring applications. The hardware prototype comprises several essential components, including sensors for data collection, a processing unit for real-time on-site analysis, and a communication module to facilitate seamless integration with the cloud infrastructure.

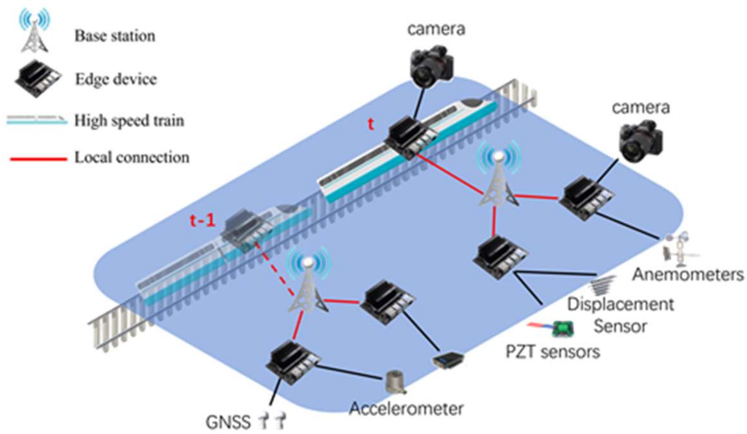


Fig. 2.47 Detailed design of hardware prototype

Since August 2022, Prof. Jiannong Cao's team has been working not only on hardware development but also on designing advanced edge AI algorithms specifically tailored for railway condition monitoring. These algorithms are designed to process sensor data in real-time, extract relevant insights, and facilitate timely decision-making to ensure the safety and efficiency of railway operations.

This approach involves employing state-of-the-art machine learning and deep learning techniques to analyse complex datasets generated by onboard sensors.

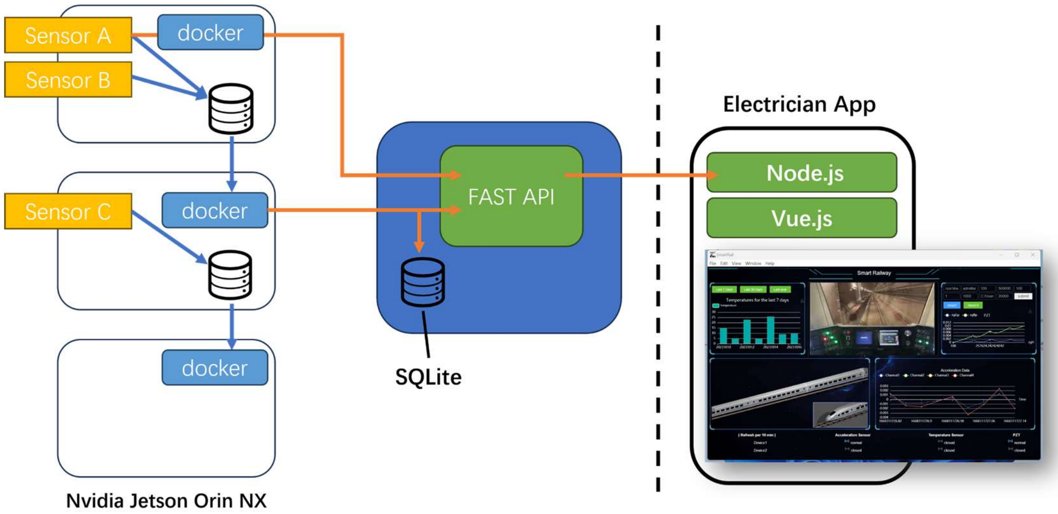


Fig. 2.48 The architecture of edge AI algorithms

Since October 2022, Prof. Jiannong Cao's team has been working on integrating the proposed railway monitoring platform with a digital twin system deployed on the cloud, as shown in Fig. 2.49. This integration aims to create a virtual representation of physical railway assets, enabling comprehensive monitoring, simulation, and predictive maintenance activities in a centralized environment. In summary, this approach encompasses the development of a hardware prototype, the design of advanced edge AI algorithms, and the integration of the railway monitoring platform with a digital twin system on the cloud. Through these initiatives, they seek to revolutionize railway condition monitoring and pave the way for safer, more efficient railway transportation systems.

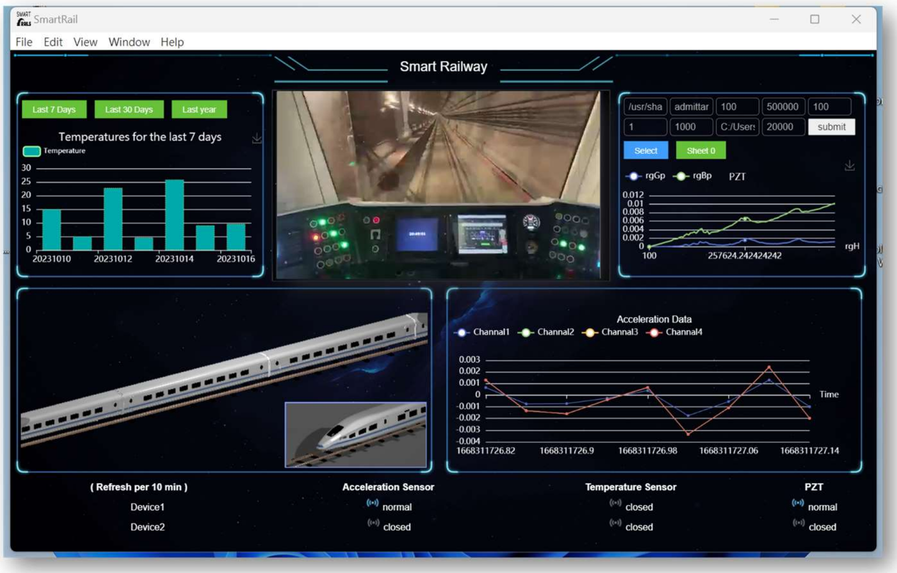


Fig. 2.49 The architecture of edge AI algorithms (Digital twin platform)

2.2.26 Evaluation of Long-Term Urban Positioning Recognition Based on Range Sensors

Traditional vision and GPS positioning can be affected by occlusion and poor weather conditions in urban environments, so more reliable location recognition methods based on range sensors need to be explored. The research uses the Boreas dataset, which contains significant seasonal variations and sensor data under different weather conditions, to simulate long-term localization scenarios in real urban environments. Evaluation metrics: The research team designed a new evaluation metric to measure the impact of matching thresholds on location recognition performance. By adjusting the matching thresholds, the robustness and accuracy of range sensors under different conditions can be evaluated. Through a series of experiments, the research team conducted a comprehensive evaluation of several state-of-the-art range sensor location recognition methods. The experimental results show that the LiDAR-based location recognition method exhibits higher robustness in severe weather conditions, while the radar-based method performs better in occluded environments. The data analytics results show the performance differences of different methods under various environmental conditions and point out the advantages and disadvantages of each. The study also suggests potential directions for further improving the range sensor positioning recognition method. The application potential of these research results in areas such as autonomous vehicles is discussed. By employing range sensor-based positioning recognition methods, the positioning accuracy and reliability of autonomous vehicles in complex urban environments can be significantly improved.

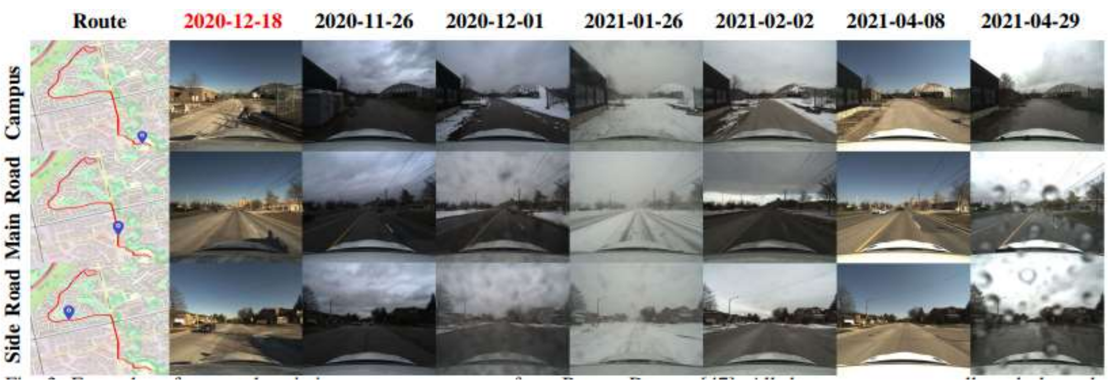


Fig. 2.50 Example of seasonal variation between series from the Boreas Dataset

2.2.27 Investigation of the Reconfigurable Ultrasonic Focusing Effect Through Acoustic Barrier

When traditional ultrasound focusing technology crosses complex acoustic barriers, it often has poor focusing effect due to energy attenuation and scattering. The research team hopes that by designing a new type of ultrasound lens, it can effectively improve the transmission efficiency and focusing effect of ultrasound when crossing this barrier. This has important implications for high-intensity focused ultrasound (HIFU) technology in the medical field, especially when treating deep tumours and other diseases that require penetrating complex tissue structures. The researchers designed an ultrasonic meta-lens attached to a hemispherical plate. This meta-lens achieves precise control of the path of sound waves by adjusting its geometric parameters, resulting in improved transmission efficiency and reconfigurable focusing. Specifically, this meta-lens takes advantage of the properties of acoustic materials, allowing ultrasound to cross the barrier with minimal energy loss and achieve efficient focusing in the target area.

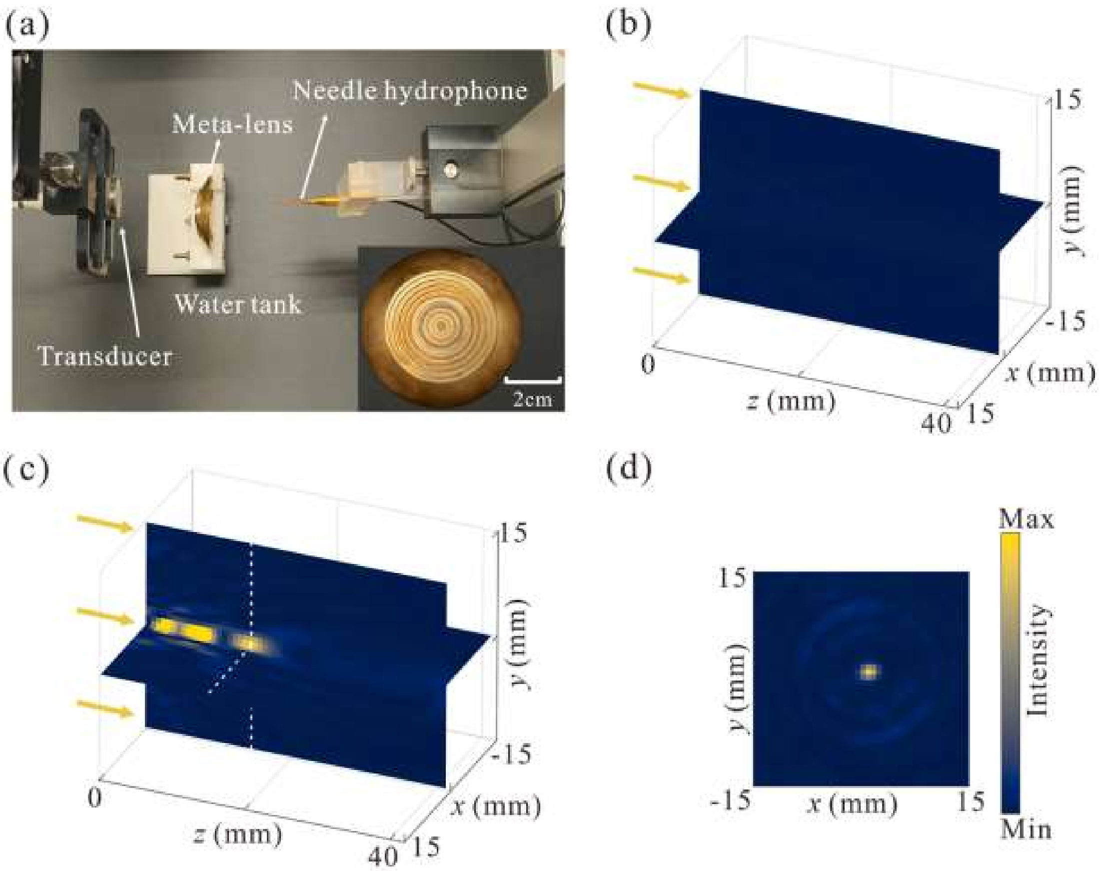


Fig. 2.51 (a) Photo of the experimental setup in the UMS3 scanning tank. The inset is the top view of the hemispherical brass plate patterned with M1; (b) and (c) Experimental intensity distributions for the hemispherical plate without and with meta-lens measured within the

region delineated by the blue dashed box in (c) and (d); (d) Experimental intensity distribution in the *xy*-section crossing the focal spot indicated by the white dashed lines in (c)

The research team carried out simulations and experimental verification. The results showed that the sound power transmission efficiency improved by nearly an order of magnitude after using this meta-lens. In addition, by adjusting the geometric parameters of the meta-lens, the researchers were able to achieve reconfigurable focusing on different focal lengths. This means that the meta-lens can be adjusted according to specific needs and flexibly respond to different treatment or imaging scenarios. This new type of ultrasound lens has a wide range of application prospects in the medical field, especially in the treatment of high-intensity focused ultrasound (HIFU). It can improve the transmission efficiency and focusing accuracy of ultrasound, thus providing better therapeutic results when treating deep tumours and other diseases that require penetrating complex tissue structures. In addition, this technology has the potential to be applied in other fields such as industrial detection and materials science. The innovation of this research is that it is not limited by the complexity of the target structure, allowing ultrasound to pass through acoustic barriers of non-uniform thickness while maintaining efficient wave focusing.

2.2.28 Development of an Optoacoustic Characterization Technique Based on Ultrafast Lasers

Ultrafast lasers are characterized by extremely short pulse widths and extremely high peak powers. The extremely short pulses enable precise energy deposition in a tiny area inside the microchip within an extremely short time. This avoids the large heat-affected zones caused by traditional long-pulse lasers, allowing for more accurate interaction with the nanoscale structures inside the microchip. When an ultrafast laser pulse irradiates the interior of a microchip, the microchip material absorbs the laser energy and rapidly undergoes thermoelastic expansion, generating ultrasonic waves, which is the photoacoustic effect. By detecting these photoacoustic signals, information about the internal structure and characteristics of the microchip can be obtained. An experimental setup is constructed, including an ultrafast laser source, a beam shaping and focusing system, and a photoacoustic signal detection system. The ultrafast laser source provides high-energy, short-pulse lasers. The beam shaping and focusing system precisely focuses the laser onto the target area inside the microchip. The photoacoustic signal detection system is used to capture and measure the weak ultrasonic signals generated by the photoacoustic effect. For different types and structures of microchips, corresponding experimental procedures are designed. For example, by controlling parameters such as the laser wavelength, pulse energy, and repetition frequency, and by changing the angle, position, and time sequence of laser irradiation, different regions and features inside the microchip are scanned and detected to obtain comprehensive three-dimensional nanoscale internal information. During the experiment, high-precision sensors and data acquisition devices are used to record in real-time the changes in parameters such as the intensity, frequency, and phase of the photoacoustic signals over time and space. These data contain rich information about the nanostructures inside the microchip, such as the distribution of material composition, density, and elastic modulus. Advanced signal processing and image processing algorithms are employed to perform operations such as denoising, filtering, and feature extraction on the collected photoacoustic signal data. Through three-dimensional reconstruction algorithms, the processed photoacoustic signal data is converted into three-dimensional images of the microchip's interior, intuitively presenting information such as the shape, size, position, and distribution of the nanoscale features inside the microchip.

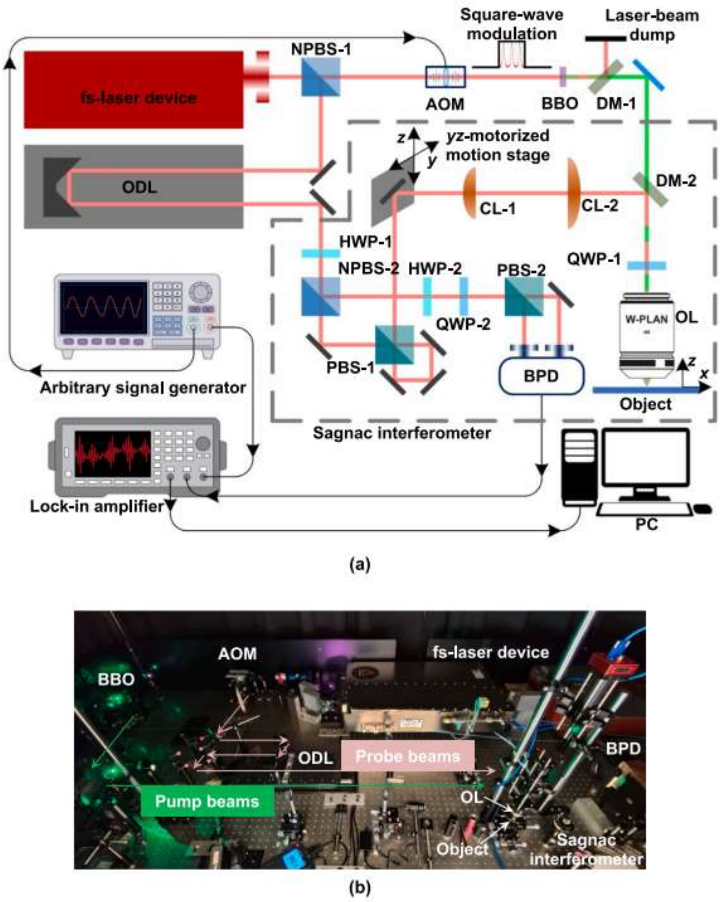


Fig. 2.52 (a) The schematic of the configurated fs-laser pump–probe set-up with a Sagnac interferometer (Shown in the gray dash frame), where all the unspecified optical components are reflectors corresponding to either the wavelengths of pump or probe beams and the red-green dash bold lines mean co-existence of 515 nm and 1,030 nm laser beams (same hereinafter). The curve-arrays signify the transmitting directions of signals; (b) The

photography of the configured set-up, where the main optical components and the pump and probe beam paths are labelled

This technology is applied to the actual production and quality inspection of microchips. It can detect nanoscale defects inside the microchip, such as voids, cracks, and impurities, and can also perform precise three-dimensional imaging and characterization of the nanoscale circuit structures, transistors, etc. inside the microchip. This provides important references for microchip design optimization, manufacturing process improvement, and quality control. The ultrafast laser photoacoustic characterization technology is compared with other traditional microchip detection technologies, such as electron microscopy and X-ray computed tomography, through comparative experiments.

The advantages and uniqueness of this technology in detecting three-dimensional nanoscale internal features, such as higher resolution, shorter detection time, and non-destructive detection of internal structures, are verified. In summary, this research is committed to developing an ultrafast laser-based photoacoustic characterization technology to achieve high-precision, non-invasive detection and imaging of the three-dimensional nanoscale internal features of microchips, providing important technical support for the development and application of microchip technology.

2.2.29 Development of CFRP Composite with Self-Sensing Function

With the growth of demand for high-performance composite materials in industries such as aerospace and automobile manufacturing, carbon fiber reinforced polymer (CFRP) composites are favoured for their excellent properties. However, they are easily damaged, so real-time monitoring of their structural integrity is extremely important. Traditional monitoring methods that integrate external sensors will reduce performance and increase costs. Additive manufacturing technology provides a new way to develop CFRP composites with self-sensing functions. The purpose of this article is to develop CFRP composites with self-sensing functions. Adopt nylon and carbon fiber filaments, graphene/cellulose nanocrystal nanocomposite ink and conductive silver ink. A hybrid printing method is adopted, combining fused deposition modelling (FDM) and aerosol jet printing (AJP) technologies. First, using FDM technology, nylon filament and continuous carbon fiber filament are continuously printed through independent print heads to form a CFRP composite material structure. Discuss the selection of optimal printing parameters during the AJP process. When the gas flow rate is set to 600 sccm, the nebulizer gas flow rate is also 600 sccm, and the table speed is 10 mm/s, the best printing effect can be obtained to ensure the uniform distribution of graphene/cellulose nanocrystals in the sensing unit and the formation of a stable conductive network. Then, using AJP technology, graphene/cellulose nanocrystal nanocomposite ink is sprayed onto the insulating layer at a specific position of the CFRP laminate to form an independent sensing unit, and silver ink is used to connect each sensing unit to form a sensing network.

Graphene/cellulose nanocrystals were observed to be uniformly and well dispersed in the sensing unit through scanning electron microscopy (SEM), with no obvious aggregation phenomenon. As the number of prints increases, the resistance of the sensing unit gradually decreases and tends to be stable, and the electrical performance is optimized. Through SEM analysis and interlaminar shear strength (ILSS) testing, it is confirmed that the "fully additive manufacturing" technology is effective in maintaining the structural integrity of composites. The impact of the embedded sensing unit on the interface integrity of CFRP composites is negligible. This functionalized CFRP composite material has extremely high sensitivity to quasi-static strains caused by cyclic loads and ultrasonic elastic disturbances up to 200 kHz.

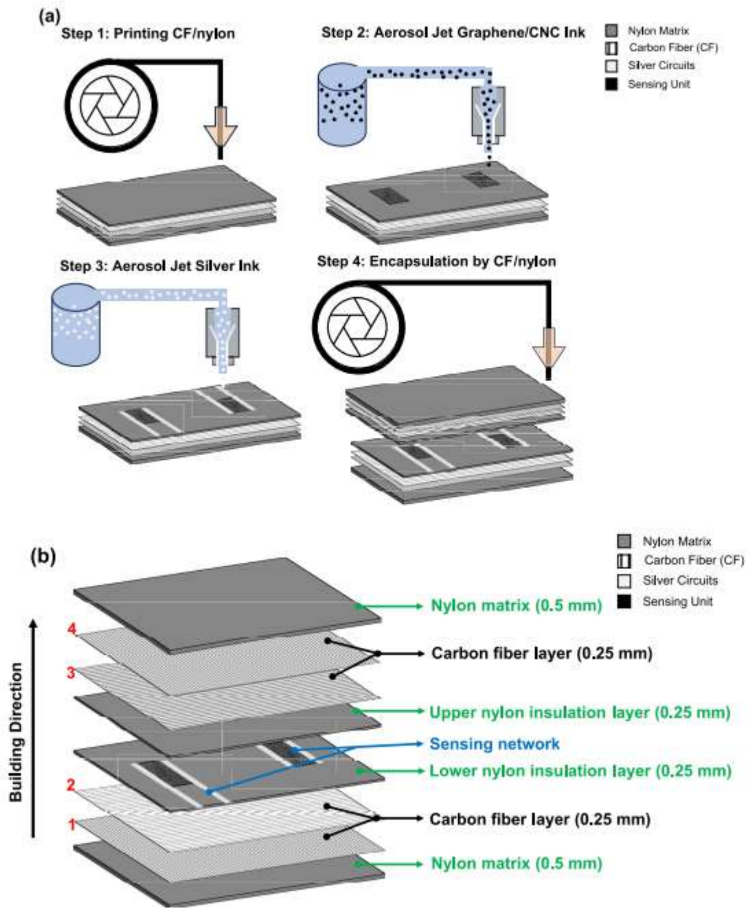


Fig. 2.53 Schematic of the concept of "totally-additive-manufacturing"-functionalized CFRP composites: (a) the printing process; (b) exploded illustration of the printed functionalized CFRP composites, including the thickness and sequence of each layer

2.2.30 Development of One-Shot Global Localization Using Semantic Triplet in Urban Environments

In fields such as autonomous driving and robot navigation, accurate global localization is of utmost importance. Traditional localization methods may face challenges in complex urban environments, such as satellite signal obstruction and similar environmental features. With the development of computer vision and deep learning technologies, using image semantic information for localization has emerged as a promising research direction. The aim is to propose an efficient and accurate global localization method that can achieve precise localization in urban environments with just a single observation (one-shot). Semantic triplets are utilized to enhance the robustness and accuracy of localization. Objects or scene elements in urban environments may be defined as semantic triplets, for example, "Building - street - tree". Through techniques such as image semantic segmentation and recognition, these semantic triplets are extracted. CNNs and other models in deep learning are employed to train on a large number of urban environment images, learning how to automatically extract the feature representations of semantic triplets. The extracted semantic triplets are used to construct a semantic map. Different locations in the urban environment are associated with corresponding semantic triplets to form a global semantic map database. When a new image is given, the semantic triplet features within it are extracted through an algorithm. Then, a match is carried out in the semantic map to find the location corresponding to the most similar semantic triplet, thus achieving one-shot global localization. Some similarity calculation methods may be adopted, such as cosine similarity and Euclidean distance, to measure the matching degree between the semantic triplets of the new image and those in the map.

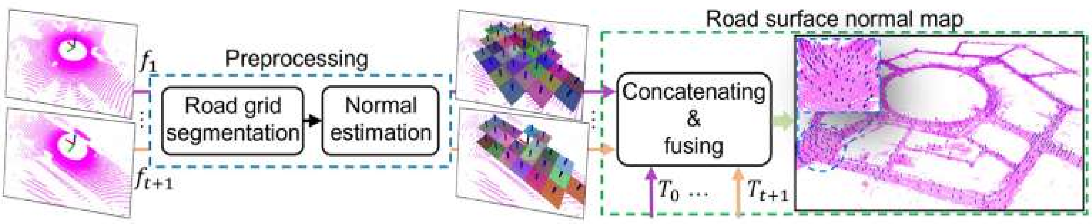


Fig. 2.54 The construction pipeline of the RSN map

Public or self-collected urban environment image datasets are used, covering urban scenes under different seasons, weather conditions, and times of the day, to verify the generalization ability of the method. The method is compared with other classic global localization methods, such as those based on visual odometry and those based on LiDAR. Propose the limitations of the research and possible directions for future improvement, such as further increasing the localization speed and expanding the application to more complex environments.

2.3 Research Outcomes

In 2024, CNERC-Rail (HK Branch) published 66 SCI papers, delivered 24 keynote reports, attended conferences 25 times, received 19 awards, submitted 10 patents, including 2 authorized patents.

2.3.1 International Journal Publications

1. Yang, W.C., Zhao, L., Deng, E., Ni, Y.Q., Zhao, W., Liu, Y.K., and Ouyang, D.H. (2024), "Spatial-temporal characteristics of the transient flow field around high-speed trains transiting the subgrade-cutting transition section under crosswinds", *Alexandria Engineering Journal*, Vol. 86, pp. 34-48. https://doi.org/10.1016/j.aej.2023.11.042 (SCI)

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2.3.2 Theme Reports

1. Ni, Y.Q. (2024), Keynote speaker: the 1st Urban Safety Forum, January 19-21, 2024, Beijing, China. (Fig. 2.55)

Fig. 2.55 Prof. Yi-Qing Ni giving a keynote report at the 1st Urban Safety Forum

2. Ni, Y.Q. (2024), Keynote speaker: the 1st Railway Operation Safety Assurance Technology Workshop, April 12, 2024, Chengdu, China.

3. Ni, Y.Q. (2024), Keynote speaker: the 1st Sichuan, Chongqing and Hong Kong Low-Carbon Intelligent Construction Technology Seminar, April 13-14, 2024, Chengdu, China.

4. Ni, Y.Q. (2024), Keynote speaker: the 2nd Greater Bay Area Modern Railway Transportation Technology Forum (Bay Area Forum) and the 4th Guangdong-Hong Kong-Macao Greater Bay Area Modern Railway Transportation Co-Innovation Centre Annual Conference, May 24-26, 2024, Hong Kong, China. (Fig. 2.56)

Fig. 2.56 Prof. Yi-Qing Ni giving a keynote report at the 2nd Greater Bay Area Modern Railway Transportation Technology Forum (Bay Area Forum) and the 4th Guangdong-Hong Kong-Macao Greater Bay Area Modern Railway Transportation Co-Innovation Centre Annual Conference

5. Ni, Y.Q. (2024), Keynote speaker: 2024 World Transport Convention, June 26-29, 2024, Qingdao, China.

6. Ni, Y.Q. (2024), Keynote speaker: the 1st Infrastructure Engineering Taishan Forum and the Science and Technology Forum on High-Quality Development of Modern Civil Engineering, July 12-14, 2024, Jinan, China.

7. Ni, Y.Q. (2024), Keynote speaker: the 12th Cross-strait Workshop on Monitoring and Control in Civil Engineering (CSW-MCCE 2024), August 8-11, 2024, Hangzhou, China.

8. Ni, Y.Q. (2024), Keynote speaker: The 2024 World Congress on Advances in Civil, Environmental, and Materials Research and the 2024 Structures Congress (ACEM24 and Structures 24), August 19-22, 2024, Seoul, Korea (Fig. 2.57).

Fig. 2.57 Prof. Yi-Qing Ni giving a keynote report at ACEM24

9. Ni, Y.Q. (2024), Keynote speaker: the 378th Shuangqing Forum: "Key Frontier Scientific Issues in Road and Bridge Engineering for High Toughness, Longevity, and Intelligent Green Development", October 18-19, 2024, Nanjing, China.
10. Ni, Y.Q. (2024), Keynote speaker: the 10th National Conference on Structural Vibration Control and Health Monitoring, November 1-3, 2024, Xiamen, China.
11. Ni, Y.Q. (2024), Keynote speaker: the 6th China High-Speed Railway Health Management Technology Forum, November 2-4, 2024, Nanchang, China.
12. Ni, Y.Q. (2024), Keynote speaker: the 2nd Annual Academic Conference on Science and Technology Security and Governance, November 17-19, 2024, Zhuhai, China.
13. Ni, Y.Q. (2024), Keynote speaker: the 1st Conference on Intelligent and Green Construction of Bridges and the 1st Academic Conference on Intelligent Construction and Maintenance of Geotechnical and Tunnel Engineering in Extreme Environments, November 22-24, 2024, Chengdu, China.
14. Ni, Y.Q. (2024), Keynote speaker: Mainland-Hong Kong Forum on the Frontiers of Civil Engineering Intelligence, December 1-3, 2024, Hong Kong, China (Fig. 2.58).

Fig. 2.58 Prof. Yi-Qing Ni giving a keynote report at Mainland-Hong Kong Forum on the Frontiers of Civil Engineering Intelligence

15. Su. Z.Q. (2024), Keynote speaker: the 20th World Conference on Non-Destructive Testing (20th WCNDT), May 27-31, 2024, Incheon, Korea.

16. Su. Z.Q. (2024), Keynote speaker: the 12th International Conference on Condition Monitoring and Asset Management (CM2024), June 18-20, 2024, Oxford, UK.

17. Su. Z.Q. (2024), Keynote speaker: the 2024 Far East NDT Forum, June 24-27, 2024, Zhongshan, China (Fig. 2.59).

Fig. 2.59 Prof. Zhongqing Su giving a keynote report at the 2024 Far East NDT Forum

18. Su. Z.Q. (2024), Keynote speaker: the 14th International Conference on Metamaterials, Photonic Crystals and Plasmonics (META 2024), July 16-19, 2024, Toyama, Japan.

19. Su. Z.Q. (2024), Keynote speaker: The 51st Annual Review of Progress in Quantitative Nondestructive Evaluation (QNDE 2024), July 22-24, 2024, Denver, CO., USA (Fig. 2.60).

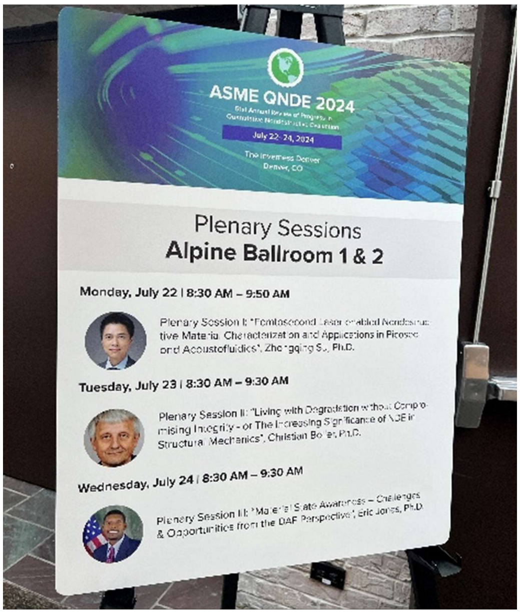

Fig. 2.60 Prof. Zhongqing Su giving a keynote report at QNDE 2024

20. Su. Z.Q. (2024), Keynote speaker: the 26th International Congress of Theoretical and Applied Mechanics (ICTAM 2024), August 25-30, 2024, Daegu, Korea.

21. Su. Z.Q. (2024), Keynote speaker: The 7th International Symposium on Laser Ultrasonics & Advanced Sensing (LU2024), October 21-25, 2024, Nanjing, China (Fig. 2.61).

Fig. 2.61 Prof. Zhongqing Su giving a keynote report at LU2024

22. Su. Z.Q. (2024), Keynote speaker: The 1st National Congress on Ultrasonics, November 1-4, 2024, Xi'an, China (Fig. 2.62).

Fig. 2.62 Prof. Zhongqing Su giving a keynote report at the 1st National Congress on Ultrasonics

23. Chen. Z.W. (2024), Keynote speaker: the 1st International Workshop on INTACT: Intelligent Tropical-storm-resilient System for Coastal Cities (INTACT2024), August 25, 2024, Hong Kong, China (Fig. 2.63).

Fig. 2.63 Dr. Zheng-Wei Chen giving a keynote report at INTACT2024

24. Deng, E. (2024), Keynote speaker: the 1st International Workshop on INTACT: Intelligent Tropical-storm-resilient System for Coastal Cities (INTACT2024), August 25, 2024, Hong Kong, China (Fig. 2.64).

Fig. 2.64 Dr. E Deng giving a keynote report at INTACT2024

2.3.3 International Conferences

1. Chen, S.M., and Or, S.W. (2024), “Nondispersive infrared carbon dioxide sensors with ray-guided multi-reflector and dome collector for electrical and environmental monitoring”, *The 10th International Conference on Power Electronics Systems and Application (PESA)*, June 5-7, 2024, Hong Kong, China.

2. Chen, Z.W., Zeng, G.Z., and Ni, Y.Q. (2024), “Effect of dynamic process of leeward side deflector wings on transient aerodynamic performance of high-speed trains under crosswinds”, *2024 World Transportation Convention*, June 25-29, 2024, Qingdao, China.

3. Dang, D.Z., Wang, Y.W., and Ni, Y.Q. (2024), “A guided wave testing method for railway cracks identification using optical fiber sensing and orthogonal matching pursuit”, *2024 World Transportation Convention*, June 25-29, 2024, Qingdao, China.

4. Deng, E, Liu, Y.K., Yue, H., Liu, X.Y., and Ni, Y.Q. (2024), "Aerodynamic impacts of high-speed trains on city-oriented noise barriers: a moving model experiment", *2024 World Transportation Convention*, June 25-29, 2024, Qingdao, China.

5. Guo, Z.J., Chen, Z.W., and Ni, Y.Q. (2024), "Determination of wind turbine type for wind energy collection in railway tunnels", *2024 World Transportation Convention*, June 25-29, 2024, Qingdao, China.

6. Zhu, Q., Wang, S.M., and Ni, Y.Q. (2024), "Cooperative control of maglev levitation system via multi-agent deep reinforcement learning", *2024 World Transportation Convention*, June 25-29, 2024, Qingdao, China.

7. Cai, K., Huang, M.F., Dong, Y., and Ni, Y.Q. (2024), "Comparative study of wind parameters during Typhoon event under stationary and non-stationary wind models", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

8. Chen, X.Y., Chen, Z.W., Ni, Y.Q., Tan, Z.X., and Zhu, L.D. (2024), "Experimental investigation on the aerodynamic force and pressure on rectangular section with side ratio of 3:2 under accelerating flow", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

9. Chen, Z.L., Lai, S.K., Yang, Z.C., and Ni, Y.Q. (2024), "Wind-induced vibration analysis of a standing glass structure by an advanced time-marching physics-informed neural network", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

10. Chen, Z.W., Guo, Z.J., and Ni, Y.Q., (2024), "Risk mitigation method for air-induced instability of maglev train based on surface airflow control", *The 12th National Conference on Magnetic Levitation Technology and Vibration Control Conference*, July 26-29, Zhuhai, China.

11. Chen, Z.W., Guo, Z.J., and Ni, Y.Q., (2024), "Application of air-blowing in mitigating the risk of train overturning", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

12. Deng, E, and Ni, Y.Q. (2024), "Synchronous wind-rain monitoring network during

typhoons in Hong Kong", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

13. Dong, Y. (2024), "Fragility modeling of tall buildings subjected to windborne debris during hurricanes", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

14. Guo, Z.J., Chen, Z.W., and Ni, Y.Q., (2024), "Aerodynamic threat of severe wind condition to the running safety of maglev train", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

15. Hu, W.B., Chen, Z.W., and Ni, Y.Q., (2024), "Robust pixel-level crack detection for glass curtain wall using synthetic images and EdgeEnhanced-DNet", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

16. Lu, J.H., Chen, Z.W., and Ni, Y.Q., (2024), "Enhancing meteorological forecasting in extreme climate conditions with spatio-temporal graph neural networks and transformer deep learning technology", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

17. Rui, E.Z., Chen, Z.W., and Ni, Y.Q., (2024), "Effects of building complexes on low-level wind shear around an airport: a wind tunnel test", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

18. Zeng, G.Z., Chen, Z.W., and Ni, Y.Q., (2024), "Sensitivity analysis of WRF–CFD downscaling method for evaluation of urban wind field distribution under typhoon environment", *The 2024 World Congress on Advances in Civil, Environmental, & Materials Research (ACEM24)/The 2024 Structures Congress (Structures24)*, August 19-22, 2024, Seoul, Korea.

19. Zeng, Y.J, Chen, Z.W., and Ni, Y.Q., (2024), "Tracking tropical cyclone based on deterministic meteorological variables prediction using novel moving window inverted vision transformer", *The 2024 World Congress on Advances in Civil, Environmental, & Materials*

Research (ACEM24)/The 2024 Structures Congress (Structures24), August 19-22, 2024, Seoul, Korea.

20. Wang, S.M. (2024), "Adaptive nonlinear control for maglev levitation system with flexible track via safe deep reinforcement learning approach", *The 26th International Conference on Magnetically Levitated Systems and Linear Drives*, September 18-22, 2024, Malmö, Sweden.

21. Rui, E.Z., Chen, Z.W., Li, H.W., and Ni, Y.Q. (2024), "Integration of a weak-form RANS turbulence model into PINN-based fluid simulations", *The 10th Asia Conference on Mechanical Engineering and Aerospace Engineering (MEAE 2024)*, October 18-20, 2024, Taicang, China.

22. Ding, S.Q., Qiu, L.S., Han, B.G., and Ni, Y.Q. (2024), "Biomimetic graphene oxide-layered double hydroxide heterostructures for enhanced chloride adsorption and corrosion resistance in marine concrete", *The Ninth Asia-Pacific Conference on FRP in Structures (APFIS 2024)*, December 8-11, 2024, Adelaide, Australia.

23. Lin, Z., Ding, S.Q., and Ni, Y.Q. (2024), "FBG-based relative humidity sensing system and relative humidity prediction with machine learning", *The Ninth Asia-Pacific Conference on FRP in Structures (APFIS 2024)*, December 8-11, 2024, Adelaide, Australia.

24. Yaw, Z., Lai, S.K., and Gulzari, M. (2024), "Sound absorption by acoustic metasurface at low frequencies", *The 1st International Conference on Engineering Structures (ICES2024)*, November 8-11, 2024, Guangzhou, China.

25. Su Z.Q. (2024), "On-chip photoacoustic manipulation of bio-particles using ultrafast laser", *The 10th East Asia Mechanical & Aerospace Engineering Workshop*, November 21-23, 2024, Taiwan, China.

2.3.4 Patents and Awards

1. Chinese invention patent "A lost SHM data recovery method based on low-rank Hankel matrix" (Inventors: Si-Yi Chen; You-Wu Wang; Yi-Qing Ni; Patent number: ZL202310769763.1; Grant date: June 4, 2024) (Fig. 2.65 left)

2. Chinese invention patent "A rail defect detection method, system and terminal" (Inventors: Da-Zhi Dang; You-Wu Wang; Yi-Qing Ni; Patent number: ZL202410832604.6; Grant date: November 29, 2024) (Fig. 2.65 right)

3. Chinese invention patent "Hyperspectral imaging for pavement crack detection under complex scenes" (Inventors: Si-Yi Chen; You-Wu Wang; Yi-Qing Ni; Application number: 2024119663895; Application date: December 30, 2024) (Fig. 2.66 left)

4. Chinese invention patent "Anomaly intrusion monitoring method and device based on fast-tracking and multi-directional object detection" (Inventors: Wen-Qiang Liu; Su-Mei Wang; Cong-Guang Zhang; Yi-Qing Ni; Application number: 2024109574927; Application date: 17 July, 2024) (Fig. 2.66 right)

5. Chinese invention patent "A railway track anomaly intrusion detection method, system, and drone" (Inventors: Xin-Yue Xu; Su-Mei Wang; Wen-Qiang Liu; Yi-Qing Ni; Application number: 2024109529902; Application date: July 16, 2024) (Fig. 2.67 left)

6. Chinese invention patent "A polydopamine-coated graphene nanosheet and its production method" (Inventors: Fang-Xin Zou; Zeng-Sheng Weng; Su-Mei Wang; Yi-Qing Ni; Patent number: 2024104674242; Application date: April 17, 2024) (Fig. 2.67 right)

7. Chinese invention patent "A structural response prediction method, system, intelligent terminal, and medium" (Inventors: Jian Zhou; Hong-Wei Li; You-Wu Wang; Yi-Qing Ni; Application number: 2024103592940; Application date: March 27, 2024) (Fig. 2.68 left)

8. Chinese invention patent "Time-domain assessment method and system for structural earthquake effects based on singular value decomposition" (Inventors: Jian Zhou; You-Wu Wang; Hong-Wei Li; Yi-Qing Ni; Application number: 202410436191X; Application date: April 11, 2024) (Fig. 2.68 right)

9. Chinese invention patent "Fiber Bragg grating sensor and magnetic field strength measurement device" (Inventors: Chun-Cheung Lai; Su-Mei Wang; Yi-Qing Ni; Application number: 2022116511054; Application disclosure date: June 21, 2024) (Fig. 2.69 left)

10. Chinese invention patent "Method and device for flow field prediction, terminal equipment and storage medium" (Inventors: Zheng-Wei Chen; Yi-Qing Ni, En-Ze Rui; Guang-Zhi Zeng; Application number: 2023112529890; Application disclosure date: February 9, 2024) (Fig. 2.69 right)

11. Prof. Yi-Qing Ni received the President's Awards and Faculty Awards for Outstanding Achievement 2024 (Fig. 2.70)

12. Nine members of CNERC-Rail (HK Branch) selected into the list of World's Top 2% Scientists released by Stanford University (Prof. Yi-Qing Ni; Prof. Songye Zhu; Prof. Hwa-

Yaw Tam; Prof. Jiannong Cao; Prof. Eric Ka-Wai Cheng; Prof. Zhongqing Su; Dr. You Dong; Dr. Zheng-Wei Chen; Dr. Si-Qi Ding) (Fig. 2.71-Fig. 2.77)

13. Dr. Wen-Qiang Liu received the Outstanding Associate Editors of the IEEE Transactions on Instrumentation and Measurement for 2024 (Fig. 2.78)

14. Ms. Qi Zhu's presentation is selected as a recommended poster of WTC2024 (Fig. 2.79)

15. Prof. Songye Zhu received the Editor's Featured Paper Award of Volume 300, Engineering Structures, 2024 (Fig. 2.80)

16. Prof. Songye Zhu received the First-class Award (Technological Invention Category) of Science and Technology Award, Chinese Society for Vibration Engineering, 2024 (Fig. 2.81)

17. Prof. Songye Zhu received the Outstanding Paper Award, The 8th International Conference on Protection of Structures against Hazards, 19-22 Sep 2024

18. Dr. You Dong received the Earthquake Spectra Outstanding Reviewer for 2024 (Fig. 2.82)

19. Dr. You Dong received the Outstanding Performance in Knowledge Transfer - President's Award 2024

20. Dr. You Dong received the Best Presentation Award, 1st Urban Safety Forum, Beijing, China, 2024

21. Dr. E Deng received the Transportation Safety and Environment Best Reviewer for 2024 (Fig. 2.83)

证书号第7059390号

专利公告信息

发明专利证书

发 明 名 称：基于低秩汉克矩阵的结构健康监测传感数据丢失恢复方法

专 利 权 人：香港理工大学深圳研究院

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申请日时专利权人：香港理工大学深圳研究院

申请日时发明人：陈思怡;王友武;倪一清

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2024年06月04日

第1页(共1页)

证书号第7478988号

专利公告信息

发明专利证书

发 明 名 称：一种钢轨损伤检测方法、系统及终端

专 利 权 人：香港理工大学深圳研究院

地 址：518057 广东省深圳市南山区粤海街道高新技术产业园南区粤兴一道18号香港理工大学产学研大楼205室

发 明 人：党大智;王友武;倪一清

专 利 号：ZL 2024 1 0832604.6 授权公告号：CN 118376698 B

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申请日时专利权人：香港理工大学深圳研究院

申请日时发明人：党大智;王友武;倪一清

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局长
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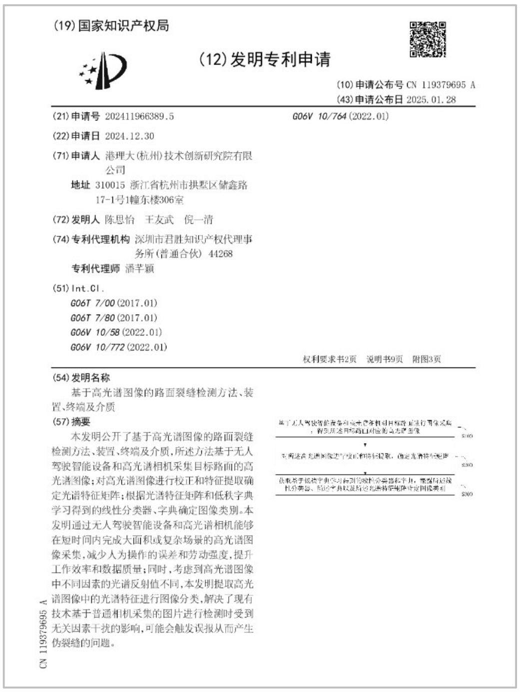
国家知识产权局
2024年10月29日

第1页(共1页)

Fig. 2.65 Patent certificates: A lost SHM data recovery method based on low-rank Hankel matrix (left); A rail defect detection method, system and terminal (right)



(19) 国家知识产权局

(12) 发明专利申请

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(71) 申请人 港理大(杭州)技术创新研究院有限公司
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专利代理师 潘芊颖

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G06T 7/00 (2017.01)
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G06V 10/772 (2022.01)
G06V 10/764 (2022.01)

权利要求书2页 说明书9页 附图3页

(54) 发明名称
基于高光谱图像的路面裂缝检测方法、装置、终端及介质

(57) 摘要
本发明公开了基于高光谱图像的路面裂缝检测方法、装置、终端及介质，所述方法基于无人驾驶智能设备和高光谱相机采集目标路面的高光谱图像；对高光谱图像进行校正和特征提取确定光谱特征矩阵；根据光谱特征矩阵和低秩字典学习得到的线性分类器、字典确定图像类别。本发明通过无人驾驶智能设备和高光谱相机能够在短时间内完成大面积或复杂场景的高光谱图像采集，减少人为操作的误差和劳动强度，提升工作效率和数据质量；同时，考虑到高光谱图像中不同因素的光谱反射值不同，本发明提取高光谱图像中的光谱特征进行图像分类，解决了现有技术基于普通相机采集的图片进行检测时受到无关因素干扰的影响，可能会触发误报从而产生伪裂缝的问题。

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深圳市南山区粤海街道高新区社区高新南七道20号深圳国家工程实验室大楼A503 深圳市君胜知识产权代理事务所（普通合伙）
王永文(0755-26406581)

发文日：
2024年07月17日

申请号：202410957492.7 发文序号：2024071701100990

专 利 申 请 受 理 通 知 书

根据专利法第28条及其实施细则第43条、第44条的规定，申请人提出的专利申请已由国家知识产权局受理。现将确定的申请号、申请日等信息通知如下：
申请号：2024109574927
申请日：2024年07月17日
申请人：港理大（杭州）技术创新研究院有限公司
发明人：刘文强,王素梅,张从广,倪一清
发明创造名称：基于快速循迹和多向目标检测的异物入侵监测方法、装置
经核实，国家知识产权局确认收到文件如下：
权利要求书 1份4页,权利要求项数 ： 10项
说明书 1份19页
说明书附图 1份5页
说明书摘要 1份1页
发明专利请求书 1份5页
实质审查请求书 文件份数：1份
申请方案卷号：243825-PI-236

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审 查 员：自动受理
联系电话：010-62356655

审查部门：初审及流程管理部

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2023.03

纸件申请，回函请寄：100088 北京市海淀区蓟门桥西土城路6号 国家知识产权局专利局受理处收
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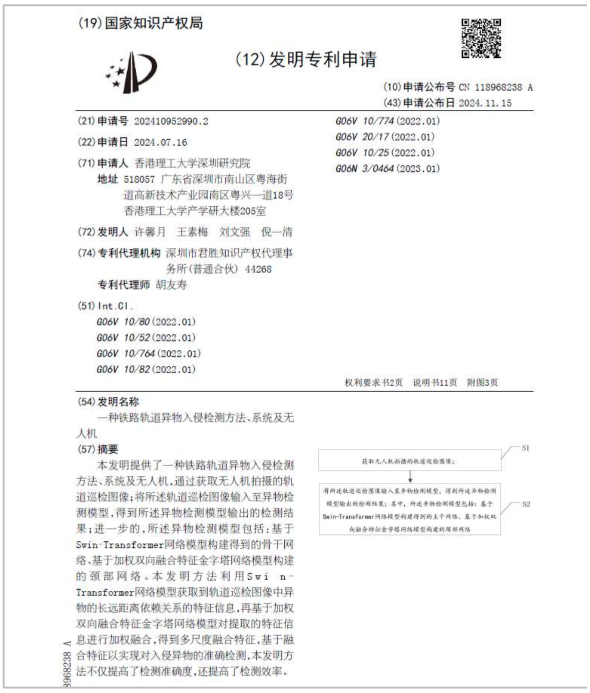
Fig. 2.66 Patent application documents: Hyperspectral imaging for pavement crack detection under complex scenes (left); Anomaly intrusion monitoring method and device based on fast-tracking and multi-directional object detection (right)



(19) 国家知识产权局

(12) 发明专利申请

(10) 申请公布号 CN 118968238 A
(43) 申请公布日 2024.11.15

(21) 申请号 202410952990.2
(22) 申请日 2024.07.16
(71) 申请人 香港理工大学深圳研究院
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(74) 专利代理机构 深圳市君胜知识产权代理事务所(普通合伙) 44268
专利代理师 胡友寿
(51) Int.Cl.
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G06V 10/764 (2022.01)
G06V 10/82 (2022.01)
G06V 10/774 (2022.01)
G06V 20/17 (2022.01)
G06V 10/25 (2022.01)
G06N 3/0464 (2023.01)

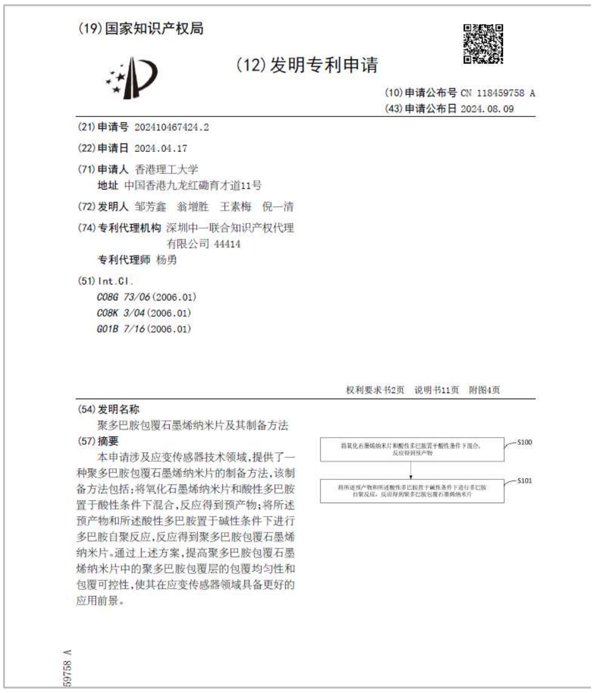
权利要求书2页 说明书11页 附图3页

(54) 发明名称
一种铁路轨道异物入侵检测方法、系统及无人机

(57) 摘要
本发明提供了一种铁路轨道异物入侵检测方法、系统及无人机,通过获取无人机拍摄的轨道巡检图像;将所述轨道巡检图像输入至异物检测模型,得到所述异物检测模型输出的检测结果;进一步的,所述异物检测模型包括:基于Swin-Transformer网络模型构建得到的骨干网络、基于加权双向融合特征金字塔网络模型构建的颈部网络。本发明方法利用Swin-Transformer网络模型获取到轨道巡检图像中异物的长远距离依赖关系的特征信息,再基于加权双向融合特征金字塔网络模型对提取的特征信息进行加权融合,得到多尺度融合特征,基于融合特征以实现对入侵异物的准确检测,本发明方法不仅提高了检测准确度,还提高了检测效率。

获取无人机拍摄的轨道巡检图像; S1
将所述轨道巡检图像输入至异物检测模型,得到所述异物检测模型输出的检测结果;其中,所述异物检测模型包括:基于Swin-Transformer网络模型构建得到的主干网络、基于加权双向融合特征金字塔网络模型构建的颈部网络 S2

CN 118968238 A



(19) 国家知识产权局

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(43) 申请公布日 2024.08.09

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(71) 申请人 香港理工大学
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(72) 发明人 邹芳鑫 翁增胜 王素梅 倪一清
(74) 专利代理机构 深圳中一联合知识产权代理有限公司 44414
专利代理师 杨勇
(51) Int.Cl.
C08G 73/06 (2006.01)
C08K 3/04 (2006.01)
G01B 7/16 (2006.01)

权利要求书2页 说明书11页 附图4页

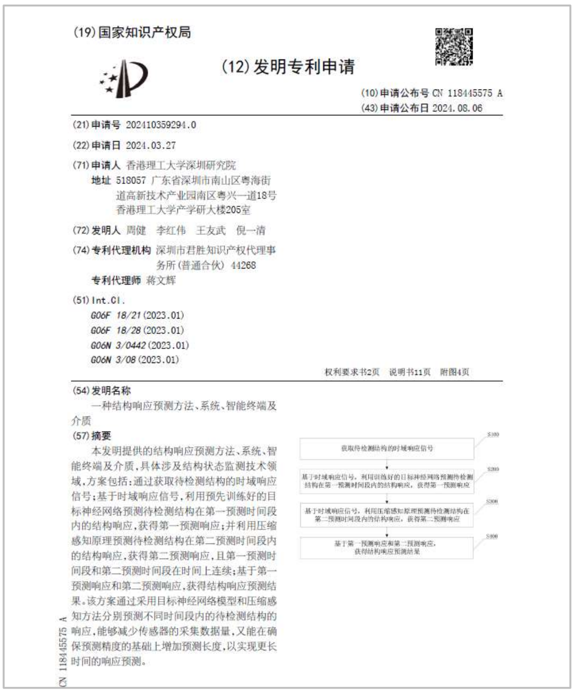
(54) 发明名称
聚多巴胺包覆石墨烯纳米片及其制备方法

(57) 摘要
本申请涉及应变传感器技术领域,提供了一种聚多巴胺包覆石墨烯纳米片的制备方法,该制备方法包括:将氧化石墨烯纳米片和酸性多巴胺置于酸性条件下混合,反应得到预产物;将所述预产物和所述酸性多巴胺置于碱性条件下进行多巴胺自聚反应,反应得到聚多巴胺包覆石墨烯纳米片。通过上述方案,提高聚多巴胺包覆石墨烯纳米片中的聚多巴胺包覆层的包覆均匀性和包覆可控性,使其在应变传感器领域具备更好的应用前景。

将氧化石墨烯纳米片和酸性多巴胺置于酸性条件下混合,反应得到预产物 S100
将所述预产物和所述酸性多巴胺置于碱性条件下进行多巴胺自聚反应,反应得到聚多巴胺包覆石墨烯纳米片 S101

59758 A

Fig. 2.67 Patent application documents: A railway track anomaly intrusion detection method, system, and drone (left); A polydopamine-coated graphene nanosheet and its production method (right)



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(22) 申请日 2024.03.27
(71) 申请人 香港理工大学深圳研究院
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专利代理师 蒋文辉
(51) Int.Cl.
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G06F 18/28 (2023.01)
G06N 3/0442 (2023.01)
G06N 3/08 (2023.01)

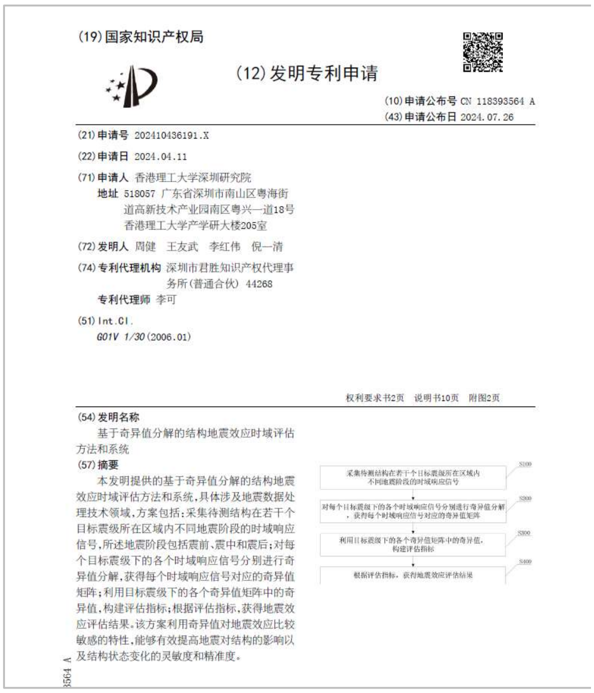
权利要求书2页 说明书11页 附图4页

(54) 发明名称
一种结构响应预测方法、系统、智能终端及介质

(57) 摘要
本发明提供的结构响应预测方法、系统、智能终端及介质,具体涉及结构状态监测技术领域,方案包括:通过获取待检测结构的时域响应信号;基于时域响应信号,利用预先训练好的目标神经网络预测待检测结构在第一预测时间段内的结构响应,获得第一预测响应;并利用压缩感知原理预测待检测结构在第二预测时间段内的结构响应,获得第二预测响应,且第一预测时间段和第二预测时间段在时间上连续;基于第一预测响应和第二预测响应,获得结构响应预测结果。该方案通过采用目标神经网络模型和压缩感知方法分别预测不同时间段内的待检测结构的响应,能够减少传感器的采集数据量,又能在确保预测精度的基础上增加预测长度,以实现更长时间的响应预测。

获取待检测结构的时域响应信号 S100
基于时域响应信号,利用训练好的目标神经网络预测待检测结构在第一预测时间段内的结构响应,获得第一预测响应 S200
基于时域响应信号,利用压缩感知原理预测待检测结构在第二预测时间段内的结构响应,获得第二预测响应 S300
基于第一预测响应和第二预测响应,获得结构响应预测结果 S400

CN 118445575 A



(19) 国家知识产权局

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(71) 申请人 香港理工大学深圳研究院
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(72) 发明人 周健 王友武 李红伟 倪一清
(74) 专利代理机构 深圳市君胜知识产权代理事务所(普通合伙) 44268
专利代理师 李可
(51) Int.Cl.
G01V 1/30 (2006.01)

权利要求书2页 说明书10页 附图2页

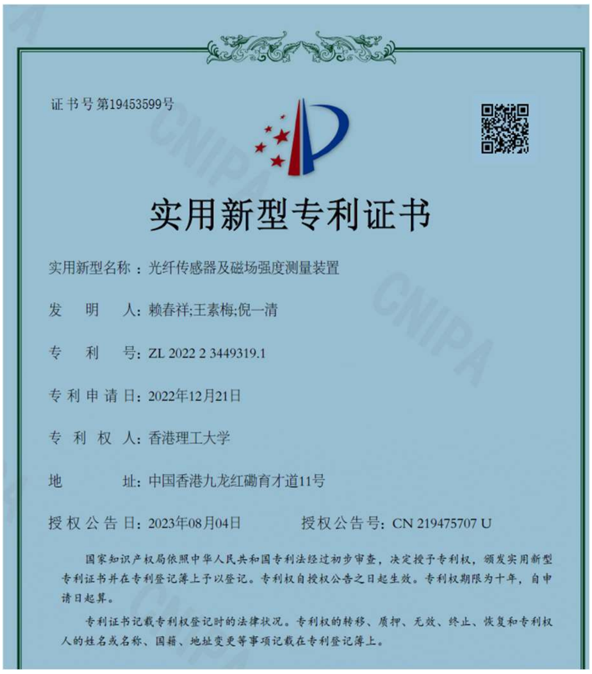
(54) 发明名称
基于奇异值分解的结构地震效应时域评估方法和系统

(57) 摘要
本发明提供的基于奇异值分解的结构地震效应时域评估方法和系统,具体涉及地震数据处理技术领域,方案包括:采集待测结构在若干个目标震级所在区域内不同地震阶段的时域响应信号,所述地震阶段包括震前、震中和震后;对每个目标震级下的各个时域响应信号分别进行奇异值分解,获得每个时域响应信号对应的奇异值矩阵;利用目标震级下的各个奇异值矩阵中的奇异值,构建评估指标;根据评估指标,获得地震效应评估结果。该方案利用奇异值对地震效应比较敏感的特性,能够有效提高地震对结构的影响以及结构状态变化的灵敏度和精准度。

采集待测结构在若干个目标震级所在区域内不同地震阶段的时域响应信号 S100
对每个目标震级下的各个时域响应信号分别进行奇异值分解,获得每个时域响应信号对应的奇异值矩阵 S200
利用目标震级下的各个奇异值矩阵中的奇异值,构建评估指标 S300
根据评估指标,获得地震效应评估结果 S400

3564 A

Fig. 2.68 Patent application documents: A structural response prediction method, system, intelligent terminal, and medium (left); Time-domain assessment method and system for structural earthquake effects based on singular value decomposition (right)



证书号第19453599号

实用新型专利证书

实用新型名称：光纤传感器及磁场强度测量装置

发　明　人：赖春祥;王素梅;倪一清

专　利　号：ZL 2022 2 3449319.1

专利申请日：2022年12月21日

专利权人：香港理工大学

地　　址：中国香港九龙红磡育才道11号

授权公告日：2023年08月04日　　授权公告号：CN 219475707 U

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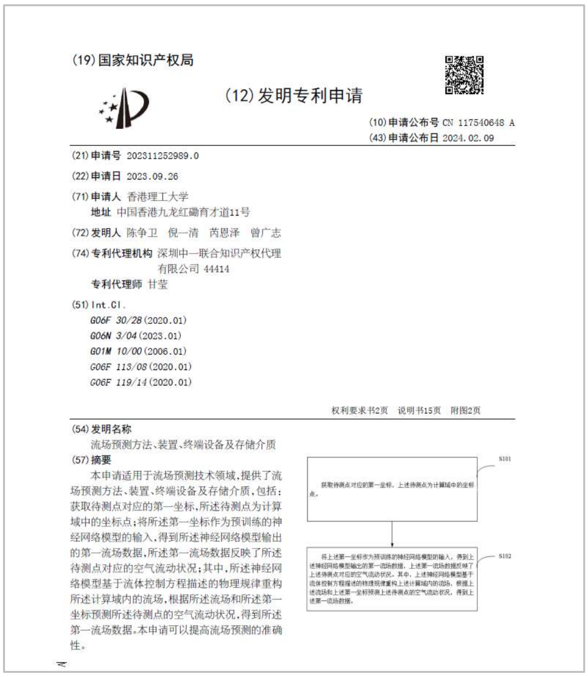

(19) 国家知识产权局

(12) 发明专利申请

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(22) 申请日 2023.09.26

(71) 申请人 香港理工大学
地址 中国香港九龙红磡育才道11号

(72) 发明人 陈争卫 倪一清 芮恩泽 曾广志

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专利代理师 甘莹

(51) Int.Cl.
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G06N 3/04 (2023.01)
G01M 10/00 (2006.01)
G06F 113/08 (2020.01)
G06F 119/14 (2020.01)

权利要求书2页 说明书15页 附图2页

(54) 发明名称
流场预测方法、装置、终端设备及存储介质

(57) 摘要
本申请适用于流场预测技术领域，提供了流场预测方法、装置、终端设备及存储介质，包括：获取待测点对应的第一坐标，所述待测点为计算域中的坐标点；将所述第一坐标作为预训练的神经网络模型的输入，得到所述神经网络模型输出的第一流场数据，所述第一流场数据反映了所述待测点对应的空气流动状况；其中，所述神经网络模型基于流体控制方程描述的物理规律重构所述计算域内的流场，根据所述流场和所述第一坐标预测所述待测点的空气流动状况，得到所述第一流场数据。本申请可以提高流场预测的准确性。

Fig. 2.69 Patent application documents: Fiber Bragg grating sensor and magnetic field strength measurement device (left); Method and device for flow field prediction, terminal equipment and storage medium (right)

Fig. 2.70 Prof. Yi-Qing Ni received the President's Awards and Faculty Awards for Outstanding Achievement 2024

Fig. 2.71 Prof. Yi-Qing Ni, Prof. Songye Zhu, and Dr. You Dong selected into the list of World's Top 2% Scientists released by Stanford University

169181	Andrews, M. J.	Los Alamos National La	usa	115	1993	2018	213,404	2,924	23	14.2205	3	41	13	794	92	2,303	3.1619	2,092	1.3977	79	13.90%	209,279	3,396	25	14.7205	3	
169182	Jani, Ashesh B.	Emory University	usa	249	1998	2024	213,405	5,462	36	13.5788	5	16	58	789	100	1,403	3.1619	4,782	1.1422	220	22.83%	164,007	7,078	41	15.9340	5	
169183	Costa-Krämer, José L.	CSIC - Instituto de Mi	esp	113	1988	2022	213,409	2,465	23	9.7001	1	157	20	941	43	1,414	3.1619	2,138	1.1529	101	17.25%	206,328	2,979	27	10.9862	1	
169184	Schweigert, V. A.	Khristianovich Institu	rus	71	1994	2005	213,410	3,104	29	13.2333	1	21	22	1,254	36	1,956	3.1619	2,126	1.4600	66	24.26%	192,745	4,098	32	15.0667	1	
169185	Akin, Tayfun	Middle East Technical	tur	186	1990	2024	213,411	3,622	29	15.4667	3	24	13	408	172	3,164	3.1619	3,101	1.1680	168	10.74%	214,753	4,058	31	17.0833	3	
169186	Kim, Sangtae	Purdue University	usa	83	1984	2023	213,412	2,145	21	15.4167	12	153	24	353	68	1,786	3.1619	1,967	1.0905	73	6.04%	229,379	2,283	22	16.4167	12	
169187	Chen, Chao Shun	National Sun Yat-Sen U	twn	168	1986	2017	213,414	2,898	32	14.4595	1	14	70	1,404	89	1,816	3.1618	2,509	1.1550	140	8.52%	218,210	3,168	33	15.8206	1	
169188	Tam, Hwa Yaw	The Hong Kong Polytech	chn	743	1989	2023	213,415	12,717	56	27.9445	3	0	25	139	341	4,609	3.1618	10,201	1.2466	527	15.36%	215,599	15,025	60	30.9350	3	
169189	Park, Chul	Seoul Center for Devel	kor	47	1988	2023	213,416	1,130	18	13.5095	20	307	44	1,015	46	1,037	3.1618	846	1.3357	45	5.83%	226,511	1,200	19	14.5095	20	
169190	Codling, K.	University of Reading	gbr	117	1960	2015	213,417	3,589	28	12.8702	11	33	36	807	67	1,941	3.1618	2,351	1.5266	110	9.09%	227,656	3,948	30	13.7452	11	
169191	Dhugga, Kanwarpal S.	Centro Internacional (	mex	54	1989	2023	213,418	2,285	24	10.0004	5	193	12	839	22	1,167	3.1618	1,883	1.2135	54	11.30%	217,928	2,576	27	10.3923	5	
169192	Chen, Tao	Food and Drug Administ	usa	125	1995	2024	213,419	3,392	30	11.5358	2	61	21	528	72	1,880	3.1618	2,998	1.1314	118	21.04%	182,874	4,296	35	13.9471	2	
169193	Corporaal, Henk	Technische Universitei	nld	382	1989	2024	213,423	3,465	28	15.8775	7	82	15	152	281	2,559	3.1618	2,991	1.1585	298	25.23%	199,628	4,634	32	18.2727	7	
169194	Chen, Yudong	University of Wisconsi	usa	79	2001	2024	213,424	3,523	24	11.1500	1	100	27	956	41	1,033	3.1618	3,126	1.1270	62	6.33%	227,160	3,761	24	11.8000	1	
169195	Terpstra, Onno T.	Leids Universitair Mec	nld	227	1977	2014	213,429	4,190	33	13.6009	14	44	40	359	118	1,738	3.1618	3,758	1.1150	176	7.55%	232,816	4,532	36	13.9620	14	
169196	Uzunoglu, Mehmet	Yıldız Teknik Üniversit	tur	72	1997	2017	213,430	4,692	30	12.9083	1	11	12	982	30	3,163	3.1618	3,996	1.1742	66	4.52%	232,404	4,914	32	13.3250	1	
169197	Snell, K. D. M.	University of Leiceste	gbr	29	1981	2022	213,434	1,021	12	12.0000	21	1,011	22	1,013	24	1,013	3.1618	866	1.1790	23	1.92%	231,463	1,041	13	13.0000	21	1
169198	O'Grady, W. E.	Excet, Inc.	usa	134	1970	2017	213,437	2,779	27	13.6667	3	86	25	455	90	1,539	3.1618	2,392	1.1618	101	11.04%	221,774	3,124	30	14.7500	3	

Fig. 2.72 Prof. Hwa-Yaw Tam selected into the list of World's Top 2% Scientists released by Stanford University

143940	Peraire, Jaime	Massachusetts Institut	usa	231	1983	2024	162,380	8,770	45	24.7254	0	0	16	1,470	142	5,693	3.2765	6,617	1.3254	205	15.92%	158,924	10,431	52	27.1421	0
143941	Lamont, Elizabeth B.	COTA	usa	63	1999	2023	162,383	5,203	30	12.4309	1	30	27	1,497	40	3,242	3.2765	4,647	1.1196	61	3.92%	185,840	5,415	31	12.4309	1
143942	Peccatori, Fedro A.	Istituto Europeo di Or	ita	308	1987	2024	162,384	10,421	51	15.9501	1	6	22	865	86	2,394	3.2765	7,726	1.3488	262	16.69%	159,344	12,509	58	17.5554	1
143943	Patterson, John C.	The University of Sydr	aus	159	1976	2021	162,386	3,343	30	19.0000	5	41	18	753	98	2,554	3.2765	2,047	1.6331	129	26.94%	127,090	4,576	39	24.0000	5
143944	Ji, Jian	Zhejiang University	chn	330	1997	2024	162,387	12,639	60	26.9398	0	0	21	315	208	8,267	3.2765	10,680	1.1834	312	12.67%	162,461	14,473	66	29.7259	0
143945	Zavascki, Alexandre Pr	Universidade Federal (	bra	167	2004	2024	162,388	4,429	33	12.8724	9	22	46	1,829	95	3,163	3.2765	3,382	1.3096	142	13.65%	161,834	5,129	36	13.5939	9
143946	Sehgal, L. M.	Rheinisch-Westfälische	deu	120	1966	2012	162,389	2,558	25	16.3922	35	199	53	443	110	2,328	3.2765	1,764	1.4501	88	4.34%	183,815	2,674	25	16.7255	35
143947	Cao, Jiannong	The Hong Kong Polytech	hkg	971	1995	2024	162,391	14,604	59	27.5730	4	0	124	631	343	3,453	3.2765	13,067	1.1176	780	12.71%	167,241	16,731	63	28.8933	4
143948	Rapp, Robert P.	University of Kentucky	usa	179	1973	2012	162,393	3,059	30	12.6361	25	219	70	669	102	1,484	3.2765	2,674	1.1440	129	1.23%	190,940	3,097	30	12.6361	25
143949	Sleep, Brent E.	University of Toronto	can	135	1989	2023	162,396	4,160	34	17.5802	3	60	18	559	75	1,744	3.2765	3,250	1.2800	118	14.79%	163,438	4,882	37	18.9135	3
143950	Heinig, M. Jane	University of Califorr	usa	111	1989	2023	162,399	4,089	27	9.5011	51	232	68	1,127	82	1,544	3.2765	3,388	1.2069	80	5.98%	182,124	4,349	28	9.5011	51
143951	Schneider, Ulrich	Technische Universität	aut	92	1974	2019	162,403	1,552	20	12.4811	9	568	52	1,147	84	1,482	3.2765	1,241	1.2506	63	4.37%	176,262	1,623	22	12.9053	9
143952	Ricco, Antonio J.	NASA Ames Research Cer	usa	201	1980	2024	162,406	6,972	37	14.9227	2	32	25	738	79	1,907	3.2765	6,238	1.1177	164	10.48%	161,000	7,788	41	16.6508	2
143953	Woltering, Eugene A.	LSU Health New Orleans	usa	177	1978	2021	162,408	4,932	38	13.8723	2	63	30	528	107	2,100	3.2765	4,191	1.1768	159	10.55%	167,607	5,514	39	14.9266	2
143954	Quercia, Daniele	Nokia Bell Labs	gbr	159	2002	2024	162,409	4,369	35	15.7316	3	12	36	2,229	84	2,574	3.2765	3,892	1.1226	137	9.41%	169,514	4,823	36	16.9649	3

Fig. 2.73 Prof. Jiannong Cao selected into the list of World's Top 2% Scientists released by Stanford University

48202	Aron, David	Case Western Reserve U	usa	246	1980	2024	48,201	14,770	47	23.7201	21	216	69	1,184	174	4,016	3.7157	14,073	1.0495	215	4.60%	52,786	15,482	48	24.4562	21	
48203	Zakay, Dan	Tel Aviv University	isr	95	1977	2023	48,202	4,269	32	22.6167	31	889	59	2,360	83	3,847	3.7157	2,796	1.5268	76	8.63%	51,121	4,672	34	23.7000	31	
48204	Terning, John	University of Califor	usa	143	1984	2024	48,203	41,879	49	23.1038	8	226	13	276	118	6,038	3.7157	37,797	1.1080	134	14.07%	49,513	48,739	52	24.0205	8	
48205	Knowles, Richard G.	Knowles Consulting	gbr	139	1977	2023	48,204	15,057	44	15.9426	6	86	23	4,204	41	8,868	3.7157	12,944	1.1632	123	4.66%	54,430	15,793	47	16.4138	6	
48206	Nyhan, Brendan	Dartmouth College	usa	77	2010	2024	48,205	10,260	35	17.0525	7	330	28	4,032	38	4,532	3.7157	8,350	1.2287	69	4.10%	57,068	10,699	35	17.0525	7	
48207	Stanton, Stuart L.	St George's Hospital	gbr	251	1971	2019	48,206	9,066	53	27.8929	50	175	77	906	207	5,390	3.7157	6,915	1.3111	187	4.29%	55,805	9,472	55	28.1429	50	
48208	Cheng, Ka Wai Eric	The Hong Kong Polytech	hkg	548	1990	2024	48,207	8,455	42	27.2012	19	349	75	1,331	270	3,328	3.7157	7,034	1.2020	416	11.77%	45,194	9,583	45	30.2345	19	
48209	Schmidt, Michael W. I.	Universität Zürich	che	89	1996	2016	48,208	12,110	43	18.6264	1	51	18	6,273	57	8,958	3.7156	8,961	1.3514	89	9.84%	49,541	13,431	49	19.4375	1	
48210	Klayman, D. L.	National Institutes of	usa	93	1961	1997	48,209	5,618	28	13.3385	4	1,876	42	3,514	67	4,411	3.7156	4,341	1.2942	87	0.83%	56,718	5,665	29	13.3885	4	1
48211	Jackler, Robert K.	Stanford University	usa	275	1982	2024	48,210	7,475	47	26.7492	31	138	88	2,318	186	4,616	3.7156	6,237	1.1985	231	5.70%	53,222	7,927	48	27.9492	31	
48212	Pennartz, Cyriel M.A.	Universiteit van Amste	nld	167	1987	2024	48,211	9,071	49	21.8555	6	114	29	2,418	103	6,817	3.7156	7,479	1.2129	152	12.26%	43,952	10,339	54	24.8171	6	
48213	Storey, Bayard T.	University of Pennsylv	usa	139	1966	2012	48,212	6,435	38	21.7968	19	694	41	1,117	103	5,458	3.7156	4,664	1.3797	116	5.10%	55,786	6,781	39	22.0468	19	
48214	Goodman, Gail S.	University of Califor	usa	182	1980	2024	48,213	7,096	48	24.3091	7	192	45	2,240	108	4,317	3.7156	4,428	1.6025	165	16.44%	47,510	8,492	52	25.1007	7	
48215	de Montigny, Claude	Université McGill	can	180	1971	2009	48,214	11,071	53	29.1873	8	111	29	946	117	6,116	3.7156	7,561	1.4642	165	12.40%	48,690	12,638	59	30.9373	8	

Fig. 2.74 Prof. Eric Ka-Wai Cheng selected into the list of World's Top 2% Scientists released by Stanford University

137919	Testolin, Raffaele	Università degli Studi	ita	116	1987	2023	152,243	5,764	39	12.0127	4	43	26	847	67	3,112	3.3026	4,069	1.4166	104	13.80%	148,136	6,687	43	13.2903	4
137920	Li, Jingchao	Donghua University	chn	168	2013	2024	152,245	10,975	54	16.7421	0	0	33	3,995	58	4,093	3.3026	7,741	1.4178	154	14.89%	155,055	12,895	58	17.7540	0
137921	Park, Il Kwon	Seoul National Univers	kor	94	2000	2024	152,246	3,263	33	14.9821	2	44	17	1,242	78	2,984	3.3026	2,569	1.2701	83	11.79%	164,552	3,699	34	15.0731	2
137922	Nagao, Tadaaki	National Institute for	jpn	324	1993	2024	152,248	7,999	51	18.7987	5	5	28	914	149	3,196	3.3026	6,205	1.2891	245	20.47%	125,345	10,058	56	20.5448	5
137923	Molnar, Miklos Z.	University of Utah Sch	usa	305	2004	2024	152,249	12,023	55	17.0106	1	2	63	1,944	101	2,254	3.3026	10,342	1.1625	284	16.67%	138,938	14,429	62	17.9814	1
137924	Su, Zhongqing	The Hong Kong Polytech	hkg	318	1999	2024	152,250	6,718	42	18.8813	3	2	47	2,639	166	4,036	3.3026	4,949	1.3574	249	19.52%	146,905	8,347	48	20.9794	3
137925	Gulotta, L. V.	Hospital for Special S	usa	204	2003	2024	152,251	5,326	39	15.6444	3	13	30	1,457	108	3,399	3.3026	4,152	1.2828	174	12.33%	152,754	6,075	43	16.7699	3
137926	Ferrándiz, Cristina	CSIC-UPV - Instituto c	esp	76	1994	2024	152,253	4,684	32	10.4881	2	116	12	1,285	34	1,877	3.3026	3,430	1.3656	69	13.74%	152,777	5,430	37	10.9596	2
137927	Dunbar, James A.	Deakin University	aus	234	1982	2023	152,254	5,672	34	16.2584	20	35	65	948	143	2,234	3.3026	5,339	1.0624	193	16.32%	154,454	6,778	37	17.6423	20
137928	Rosso, Renzo	Politecnico di Milano	ita	113	1977	2023	152,255	3,395	28	17.4827	4	147	13	407	91	2,476	3.3026	2,920	1.1627	91	18.64%	144,099	4,173	34	18.8993	4
137929	Yang, B.	University of Marylanc	usa	135	1994	2023	152,257	8,803	44	11.9071	1	61	22	773	48	1,235	3.3026	6,521	1.3499	108	8.25%	144,986	9,595	49	13.1071	1
137930	Licciardone, John C.	University of North Te	usa	131	1989	2024	152,258	1,970	22	13.8635	46	278	105	1,538	115	1,636	3.3026	1,521	1.2952	108	13.97%	145,399	2,290	24	15.0135	46
137931	Gentili, Alessandra	Sapienza Università di	ita	144	1997	2024	152,260	4,043	32	13.9610	4	141	30	929	51	1,225	3.3026	3,520	1.1486	125	10.41%	157,728	4,513	34	15.0483	4
137932	Sakuda, Atsushi	Osaka Metropolitan Uni	jpn	198	2008	2024	152,264	5,506	36	13.9535	3	18	34	2,306	36	2,346	3.3025	3,176	1.7336	169	18.56%	140,769	6,761	41	15.8958	3

Fig. 2.75 Prof. Zhongqing Su selected into the list of World's Top 2% Scientists released by Stanford University

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
205420	Conceição, Luis	Área Empresarial de Marim	prt	199	1993	2024	333,023	490	8	4.5564	0	0	19	41	61	122	2.2753	384	1.2760	134	17.65%	296,329	5
205421	Heydarpour, Fatemeh	Kermanshah University of Medical Sciences	irn	64	2016	2024	333,026	7,419	16	1.8116	0	0	7	20	14	27	2.2753	6,573	1.1287	45	11.47%	364,040	8,3
205422	Willard, Michael D.	Texas A&M University	usa	155	1978	2022	333,051	186	5	3.4139	32	12	80	40	109	89	2.2752	140	1.3286	61	8.37%	352,242	2
205423	Sabitha, M.	Amrita Institute of Medical Sciences India	ind	40	2003	2024	333,054	263	10	4.0262	0	0	2	38	21	199	2.2752	227	1.1586	27	3.66%	360,289	2
205424	Bertone, Alicia L.	The Ohio State University	usa	199	1984	2021	333,056	201	5	3.5267	21	8	58	32	133	146	2.2752	164	1.2256	94	1.47%	386,282	2
205425	Dalala, Zakariya	German Jordanian University	jor	50	2011	2024	333,071	220	7	2.9250	1	3	20	88	31	93	2.2752	211	1.0427	33	5.58%	283,567	2
205426	Milane, Lara	Northeastern University	usa	37	2008	2024	333,078	310	7	3.2389	6	0	20	151	23	151	2.2752	309	1.0032	19	3.73%	362,652	3
205427	Rehman, Masood Ur	University of Glasgow	gbr	185	2007	2024	333,085	412	9	3.8607	0	0	40	24	99	281	2.2752	397	1.0378	81	4.85%	375,037	4
205428	Chen, Zhengwei	The Hong Kong Polytechnic University	chn	95	2016	2024	333,086	321	10	4.5369	0	0	15	43	36	109	2.2752	160	2.0063	68	44.94%	157,812	5
205429	Ng, Siok Bian	National University of Singapore	sgp	113	2000	2024	333,097	918	10	2.8256	0	0	21	38	40	131	2.2752	793	1.1576	61	14.84%	328,475	1,0
205430	Qu, Haibin	Zhejiang University	chn	356	2003	2024	333,099	396	8	4.8468	0	0	17	20	240	262	2.2752	326	1.2147	151	17.33%	338,382	4
205431	Stephen, Craig	The University of British Columbia	can	148	1993	2024	333,103	163	5	2.9000	33	14	69	52	105	95	2.2752	141	1.1560	64	14.21%	312,990	1
205432	Sa Cunha, Antonio	Hopital Paul-Brousse	fra	225	2000	2024	333,108	862	13	4.4851	4	0	17	10	49	98	2.2752	750	1.1493	138	9.26%	365,716	9
205433	Ukhurebor, Kingsley Egh	Edo State University Uzairue	nga	91	2018	2024	333,112	345	8	3.2243	0	0	20	111	41	141	2.2752	298	1.1577	57	42.98%	145,950	6
205434	Bolić, Miodrag	University of Ottawa	can	200	1998	2024	333,116	363	9	4.8429	2	0	21	43	94	104	2.2752	325	1.1169	85	7.63%	377,597	3

Fig. 2.76 Dr. Zheng-Wei Chen selected into the list of World's Top 2% Scientists released by Stanford University

163667	Ley, Lothar	Friedrich-Alexander-Uni	deu	440	1969	2022	190,110	587	11	4.9873	13	1	41	28	243	266	2.4830	466	1.2597	140	4.55%	232,100	615	11	4.58
163668	Chojkier, Mario	National Institutes of He	usa	89	1974	2018	190,111	177	6	3.5843	5	41	25	49	76	121	2.4830	165	1.0727	40	1.12%	220,631	179	6	3.58
163669	Yang, Hao	Nanjing University of Ae	chn	232	2006	2024	190,112	348	9	5.5929	0	0	79	149	121	215	2.4830	310	1.1226	90	11.22%	208,042	392	9	5.75
163670	Rizzardini, Giuliano	Ospedale Luigi Sacco - Pc	ita	385	1985	2024	190,115	1,103	17	3.9979	1	0	17	49	72	116	2.4830	953	1.1574	180	15.15%	204,736	1,300	17	3.94
163671	Yang, Lili	Ministry of Education of	chn	299	2003	2024	190,116	843	11	5.8123	0	0	29	37	86	215	2.4830	774	1.0891	191	8.07%	213,531	917	11	5.93
163672	Kihlberg, Jan	Uppsala Universitet	swe	200	1983	2024	190,120	712	16	5.8054	1	0	15	8	113	474	2.4830	509	1.3988	91	12.42%	196,683	813	17	6.15
163673	Ding, Siqi	The Hong Kong Polytechi	hkg	50	2014	2024	190,121	489	13	4.4635	0	0	12	130	14	136	2.4830	345	1.4174	39	18.64%	158,604	601	14	5.16
163674	Jacobsen, Karen	Tufts University	usa	20	1996	2023	190,122	83	6	4.8333	8	45	15	71	19	77	2.4830	74	1.1216	11	1.19%	221,685	84	6	4.83
163675	James, Andrew M.	MRC Mitochondrial Biolc	gbr	84	1996	2023	190,124	834	14	4.2522	0	0	15	99	16	101	2.4830	656	1.2713	76	9.35%	203,866	920	15	4.43
163676	Cornwell, Edward E.	Howard University Colle	usa	300	1960	2024	190,126	812	12	4.9907	14	1	47	29	92	154	2.4830	672	1.2083	163	4.47%	219,897	850	12	4.94
163677	Saleh, S. A.	University of New Bruns	can	226	2002	2024	190,127	216	6	3.5786	30	8	198	165	209	172	2.4830	165	1.3091	90	56.63%	32,339	498	11	6.17
163678	Liu, Yongqiang	University of Southampt	gbr	84	2000	2024	190,128	354	10	6.0452	0	0	34	125	39	165	2.4830	321	1.1028	61	1.67%	219,515	360	10	6.21
163679	Persson, Lars Ake	London School of Hygien	gbr	279	1982	2024	190,131	548	10	4.9232	14	6	31	14	111	169	2.4830	464	1.1810	154	15.43%	187,091	648	10	4.98
163680	Orr, A. Wayne	School of Medicine	usa	102	2000	2024	190,132	488	11	4.9514	0	0	14	78	42	258	2.4830	399	1.2231	89	7.75%	207,545	529	12	4.90
163681	Free, Christopher M.	University of California,	usa	35	2013	2024	190,133	625	9	2.8237	0	0	18	296	19	299	2.4830	588	1.0629	27	11.35%	206,357	705	9	2.86
163682	Zou, Haidong	Shanghai General Hospit	chn	287	2002	2024	190,135	1,089	15	5.1258	4	0	24	13	141	315	2.4830	845	1.2888	176	11.17%	177,625	1,226	16	5.75

Fig. 2.77 Dr. Si-Qi Ding selected into the list of World's Top 2% Scientists released by Stanford University

ation/ieee-tim/editors#outstanding

Outstanding Associate Editors

Every year, we select the top 20% or fewer of our Associate Editors as Outstanding Associate Editors, whom we recognize at the IEEE I²MTC conference's award ceremony. These are the AEs that have demonstrated outstanding performance in terms of their timeliness, number of papers handled, and the quality of their work. To be eligible, an AE must have served on the editorial board for more than 1 year as of December 31 of the year for which the award is given.

In addition to receiving a certificate and a memento, an Outstanding AE also receives four (4) free TIM overlength pages, which can be applied against the AE's TIM paper(s) accepted within 2 years of receiving the award.

To use your free overlength pages, please wait until IEEE or CopyrightClearance informs you by email that there are charges. Then, simply forward that email to TIM's EiC. Please do not contact IEEE or its reprints department yourself: it will only delay your award.

2024 2023 2022 2021 2020 2019 2018 2017 2016 2015 2014 2013 2012 2011 2010

- Rosenda Arencibia
- Hongtian Chen
- Zhenghua Chen
- Wei Fan
- Ke Feng
- Mohamad Forouzanfar
- Alessandra Galli
- Yuan Gao
- Hamed Hamzehbahmani
- Weiguo Huang
- Grazia Iadarola
- Yandan Jiang
- Carlos Juan
- Jing Lei
- Wenqiang Liu
- Arunava Naha
- Gabriele Patrizi

Fig. 2.78 Dr. Wen-Qiang Liu received the Outstanding Associate Editors of the IEEE Transactions on Instrumentation and Measurement for 2024

Fig. 2.79 Ms. Qi Zhu's presentation is selected as a recommended poster of WTC2024

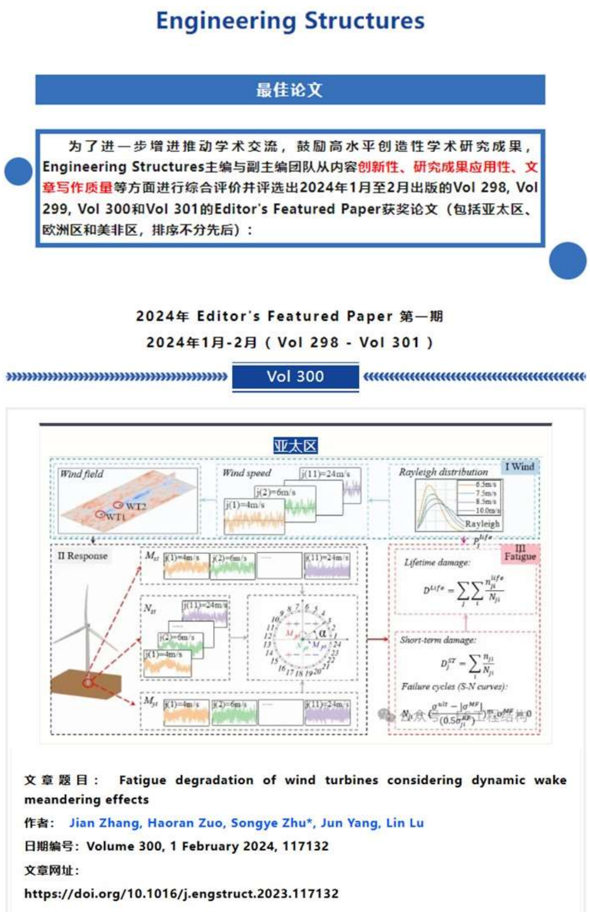


Fig. 2.80 Prof. Songye Zhu received the Editor’s Featured Paper Award of Volume 300, Engineering Structures, 2024

附件1：2024年度中国振动工程学会科学技术奖授奖项目目录

编号	项目名称	获奖等级	项目类别	主要完成人	主要完成单位
2024-KJ1-1-01	重载机车齿轮传动激励机理与系统动态特性	一等奖	基础研究	陈再刚，刘禹清，宁婕妤，王开云，翟婉明	西南交通大学
2024-KJ1-1-02	非线性振动能量俘获系统的设计及分析理论	一等奖	基础研究	周生喜，王军雷，黄冬梅，杨智春，李伟	西北工业大学，郑州大学，西安电子科技大学
2024-KJ1-1-03	泛领域跨装备的机械系统智能故障诊断与预测理论及方法	一等奖	基础研究	李巍华，何国林，严如强，陈祝云，黄如意	华南理工大学，东南大学
2024-KJ3-1-01	舰艇声振协同定量溯源技术及应用	一等奖	技术发明	成玮，乔百杰，尹家录，杨明绥，耿佳，高琳	西安交通大学，中国航发沈阳发动机研究所
2024-KJ3-1-02	海上风力机抗台风设计理论与降载减振关键技术及应用	一等奖	技术发明	柯世堂，朱松晔，王珑，许波峰，任贺贺，刘东华	南京航空航天大学，香港理工大学，河海大学，中国能源建设集团广东省电力设计研究院有限公司

Fig. 2.81 Prof. Songye Zhu received the First-class Award (Technological Invention Category) of Science and Technology Award, Chinese Society for Vibration Engineering, 2024

SPECTRA

2024 Earthquake Spectra Outstanding Reviewers

In 2024, *Earthquake Spectra* relied on the hard work and expertise of scores of reviewers to provide more than 650 manuscript reviews. To recognize these important contributions, the journal is recognizing a few reviewers each year who provided exemplary volume and quality of review insights. We would like to acknowledge the following Outstanding Reviewers for 2024:

- **Anirudh Rao**
- **Ayse Hortacsu**
- **Aysegul Askan**
- **Cassie Gann-Phillips**
- **Chiara Smerzini**
- **Francisco Galvis**
- **Mayssa Dabaghi**
- **Neal Simon Kwong**
- **You Dong**

Fig. 2.82 Dr. You Dong received the Earthquake Spectra Outstanding Reviewer for 2024

Fig. 2.83 Dr. E Deng received the Transportation Safety and Environment Best Reviewer for 2024

2.3.5 Professional Activities

1. Prof. Yi-Qing Ni, Co-Editor-in-Chief of Journal of Infrastructure Intelligence and Resilience (Publisher: Elsevier).

2. Prof. Yi-Qing Ni, Co-Editor-in-Chief of Intelligent Transportation Infrastructure (Publisher: Oxford University Press).

3. Prof. Yi-Qing Ni, Academic Editor of Structural Control and Health Monitoring: An International Journal (Publisher: Wiley & Hindawi Partnership).

4. Prof. Yi-Qing Ni, Associate Editor of Journal of Vibration and Control (Publisher: SAGE Publications).

5. Prof. Yi-Qing Ni, Associate Editor of Journal of Civil Structural Health Monitoring (Publisher: Springer).

6. Prof. Yi-Qing Ni, Member of Advisory Board for International Journal of Railway Research (Publisher: Iran University of Science and Technology Press).

7. Prof. Yi-Qing Ni, Member of Editorial Advisory Board for Journal of Intelligent Manufacturing and Special Equipment (Publisher: Emerald Publishing).

8. Prof. Yi-Qing Ni, Member of Editorial Board for Engineering Structures (Publisher: Elsevier).
9. Prof. Yi-Qing Ni, Member of Editorial Board for Smart Structures and Systems: An International Journal (Publisher: Techno-Press).
10. Prof. Yi-Qing Ni, Member of Editorial Board for Advances in Structural Engineering: An International Journal (Publisher: SAGE Publications).
11. Prof. Yi-Qing Ni, Member of Editorial Board for Advanced Steel Construction: An International Journal (Publisher: The Hong Kong Institute of Steel Construction).
12. Prof. Yi-Qing Ni, Member of Editorial Board for Structural Monitoring and Maintenance: An International Journal (Publisher: Techno-Press).
13. Prof. Yi-Qing Ni, Member of Editorial Board for Transportation Safety and Environment (Publisher: Oxford University Press).
14. Prof. Yi-Qing Ni, Member of Editorial Board for Advances in Bridge Engineering (Publisher: Springer Nature Group).
15. Prof. Songye Zhu, Member of Editorial Board for Advances in Structural Engineering (Publisher: SAGE Publications).
16. Prof. Songye Zhu, Associate Editor of International Journal of Smart and Nano Materials (Publisher: Taylor & Francis).
17. Prof. Zhongqing Su, Editor-in-Chair of Journal of Ultrasonics (Publisher: Elsevier).
18. Prof. Zhongqing Su, Associate Editor of Structural Health Monitoring: An International Journal (Publisher: SAGE Publications).
19. Dr Siu-Kai Lai, Associate Editor of Journal of Vibration Engineering & Technologies (Publisher: Springer).
20. Dr Siu-Kai Lai, Member of Editorial Board for International Journal of Dynamics and Control (Publisher: Springer).
21. Prof. Siu-Wing Or, Member of Editorial Board for Processes (Publisher: MDPI).
22. Prof. Zhi-Zhao Liu, Member of Editorial Board for GPS Solutions (Publisher: Springer).
23. Prof. Zhi-Zhao Liu, Member of Editorial Board for Satellite Navigation (Publisher: Springer Open).
24. Prof. Zhen Leng, Editor-in-Chair of Cleaner Materials (Publisher: Elsevier).
25. Prof. Zhen Leng, Member of Editorial Board for Journal of Cleaner Production (Publisher: Elsevier).
26. Prof. Zhen Leng, Member of Editorial Board for Journal of Transportation Engineering, Part B: Pavements (Publisher: ASCE).

27. Prof. Zhen Leng, Member of Editorial Board for Journal of Materials in Civil Engineering (Publisher: ASCE).
28. Prof. Zhen Leng, Member of Editorial Board for Road Materials and Pavement Design (Publisher: Taylor & Francis).
29. Prof. Zhen Leng, Member of Editorial Board for Transportation Research Part D: Transport and Environment (Publisher: Elsevier).
30. Prof. Zhen Leng, Member of Editorial Board for International Journal of Transportation Science and technology (Publisher: Elsevier).
31. Prof. Jiannong Cao, Member of Editorial Board for ACM Computing Surveys (Publisher Association for Computing Machinery).
32. Prof. Jiannong Cao, Member of Editorial Board for ACM Transactions on Cyber-Physical Systems (Publisher Association for Computing Machinery).
33. Prof. Jiannong Cao, Member of Editorial Board for ACM Transactions on Sensor Networks (Publisher Association for Computing Machinery).
34. Prof. Jiannong Cao, Member of Editorial Board for Chinese Journal of Electronics (Publisher: Chinese Institute of Electronics).
35. Prof. Jiannong Cao, Member of Editorial Board for Peer-to-Peer Networking and Applications (Publisher: Springer).
36. Prof. Li Cheng, Associate Editor of Journal of Sound and Vibration (Publisher: Elsevier).
37. Prof. Li Cheng, Associate Editor of Journal of the Acoustical Society of America (Publisher: Acoustical Society of America).
38. Prof. Li Cheng, Associate Editor of Structural Health Monitoring: An International Journal (Publisher: SAGE Publications).
39. Prof. Li Cheng, Associate Editor of Nonlinear Dynamics (Publisher: Springer).
40. Dr Wen-Qiang Liu, Member of Editorial Board for IEEE Transactions on Instrumentation and Measurement (Publisher: IEEE).
41. Dr E Deng, The Third Youth Editorial Committee Member of Journal of Central South University.
42. Dr E Deng, Youth Member of Editorial Board for Advances in Wind Engineering (Publisher: KeAi).
43. Dr E Deng, Youth Member for Technical Committee on Aerodynamics of Orbital Vehicles in Discipline of Dynamic Effect of Orbital Transport Systems in Division of Rail Transit at the Third Division Committee of World Transport Convention (WTC).

44. Dr Yue Dong, Youth Member of Editorial Board for Advances in Wind Engineering (Publisher: KeAi).
45. Dr Si-Qi Ding, Guest Editor of Communications Engineering (Publisher: Nature Portfolio).

3. Collaborations & Exchanges of CNERC-Rail (HK Branch) in 2024

3.1 Collaboration Agreements

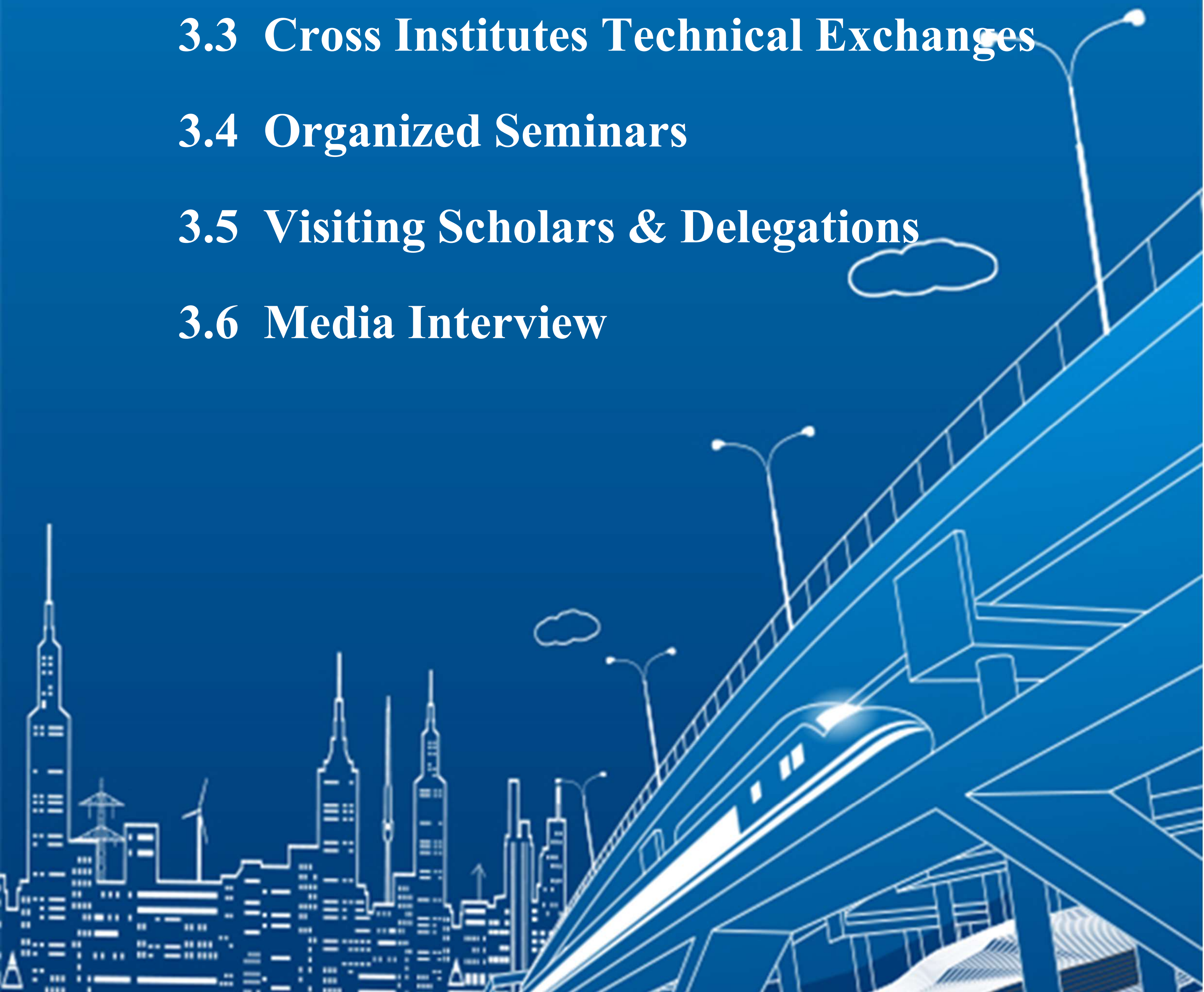
3.2 Conferences

3.3 Cross Institutes Technical Exchanges

3.4 Organized Seminars

3.5 Visiting Scholars & Delegations

3.6 Media Interview



3 Collaborations & Exchanges of CNERC-Rail (HK Branch) in 2024

3.1 Collaboration Agreements

3.1.1 Cooperation Agreement with Zhejiang Rail Transit Operation Management Group Co., Ltd. for Joint Establishment

On April 22, 2024, the CNERC-Rail (HK Branch) signed a cooperation agreement with Zhejiang Rail Transit Operation Management Group Co., Ltd. for the joint establishment of the Zhejiang Province Engineering Research Centre (see Fig. 3.1). Both parties will organize enterprises, research institutions, universities and colleges with strong research and development strength to build research and development entities based on the strategic needs of building a high-level innovative province and a modernized economic system, and with the goal of enhancing Zhejiang Province's independent innovation capability. On December 20, 2024, the unveiling ceremony of the Zhejiang Provincial Engineering Research Centre for Intelligent Operation and Maintenance of Rail Transit (hereinafter referred to as "Research Centre") was held at the headquarters of Zhejiang Communications Investment Group Co., Ltd. The Research Centre was jointly established by Zhejiang Rail Group (affiliated to Zhejiang Communications Investment Group Co., Ltd.), in collaboration with the Hong Kong Polytechnic University, Southwest Jiaotong University, the National High-Speed Train Qingdao Technology Innovation Centre, Chengdu Yunda Technology Co., Ltd., and other entities.

浙江省工程研究中心合作
共建协议书

浙江省轨道交通运营管理集团有限公司制
2024. 4. 22

（以下为《关于申报共建浙江省工程研究中心合作协议书》签署页，无正文）

甲方：浙江省轨道交通运营管理集团有限公司（盖章）
授权代表（签字）：
签约时间：

乙方： 香港理工大学（盖章）
授权代表（签字）：
签约时间：

Fig. 3.1 Cooperation agreement with the Zhejiang Rail Transit Operation Management Group Co., Ltd. for joint establishment

3.1.2 Strategic Cooperation Agreement with Beijing Electrification Engineering Co., Ltd. of China Railway Electrification Bureau Group

On December 6, 2024, the CNERC-Rail (HK Branch) and Beijing Electrification Engineering Co., Ltd. of China Railway Electrification Bureau Group signed a cooperation agreement on technology research and development and application (see Fig. 3.2). Both parties will explore opportunities for collaborative research or the establishment of a joint research laboratory and have reached a preliminary understanding on the framework for further discussions.

中铁电气化局集团北京电气化工程有限公司
香港理工大学
技术研发与应用 战略合作协议

本战略协议由以下双方签订：

甲方：中铁电气化局集团北京电气化工程有限公司

乙方：香港理工大学

双方将探讨合作研究或建立联合研究实验室之合作机会，并对进一步讨论的框架达成初步了解。就香港理工大学而言，国家轨道交通电气化与自动化工程技术研究中心（香港分中心）为执行部门。双方签订本战略合作协议作为双方目前对潜在合作范围的理解以及可进一步讨论领域的记录。

甲方： 中铁电气化局集团北京电气化工程有限公司

中铁电气化局集团北京电气化工程有限公司（以下简称"中铁电气化公司"），前身是中铁电气化局集团有限公司电气化公司，成立于 2002 年 1 月，2018 年与中铁科电气化局有限公司重组登记注册，并正式更名为中铁电气化局集团北京电气化工程有限公司，机关本部位于北京市，是世界企业和世界品牌双 500 强中国中铁股份有限公司旗下中铁电气化局集团有限公司的全资子公司。中铁电气化公司现有铁路电务工程专业承包壹级、铁路电气化工程专业承包壹级等共计 10 项资质，主要从事铁路"四电"、城市轨道交通等领域的市场开发和施工管理，是集施工管理、科研开发、器材生产为一体的管理密集型企业。公司自成立以来，先

甲方代表签字（盖章）：

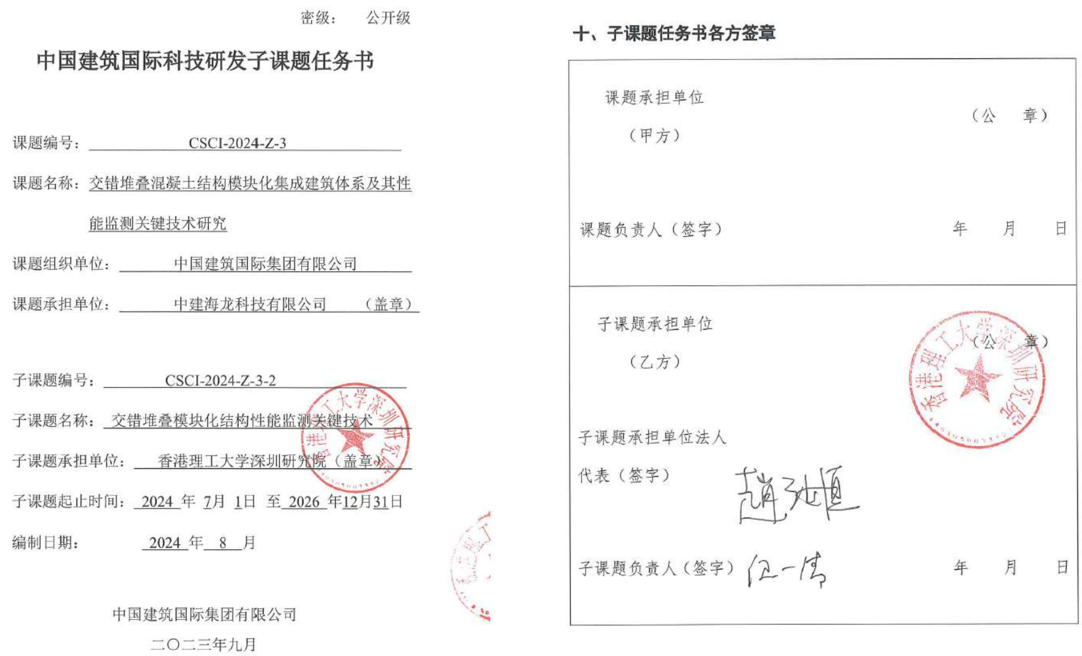
乙方代表签字（盖章）：

签订日期：2024 年 12 月 6 日

Fig. 3.2 Strategic cooperation agreement with Beijing Electrification Engineering Co., Ltd. of China Railway Electrification Bureau Group

3.1.3 Cooperation Project Agreement with China State Construction International Holdings Limited

On July 2024, the CNERC-Rail (HK Branch) signed a cooperation project agreement with China State Construction International Holdings Limited (see Fig. 3.3). Both parties will focus on key technologies for performance monitoring of modular structures and carry out full-process performance monitoring of tests on connections of modular building structures. The relevant results can provide important monitoring basis and safety guarantee technology for the high-rise development of modular structures.


密级： 公开级

中国建筑国际科技研发子课题任务书

课题编号： CSCI-2024-Z-3

课题名称： 交错堆叠混凝土结构模块化集成建筑体系及其性能监测关键技术研究

课题组织单位： 中国建筑国际集团有限公司

课题承担单位： 中建海龙科技有限公司 （盖章）

子课题编号： CSCI-2024-Z-3-2

子课题名称： 交错堆叠模块化结构性能监测关键技术

子课题承担单位： 香港理工大学深圳研究院（盖章）

子课题起止时间： 2024 年 7月 1日 至 2026 年12月31日

编制日期： 2024 年 8 月

中国建筑国际集团有限公司

二〇二三年九月

十、子课题任务书各方签章

课题承担单位（甲方） （公 章） 课题负责人（签字） 年 月 日
子课题承担单位（乙方） （公 章） 子课题承担单位法人代表（签字） 子课题负责人（签字） 年 月 日

Fig. 3.3 Cooperation project agreement with China State Construction International Holdings Ltd.

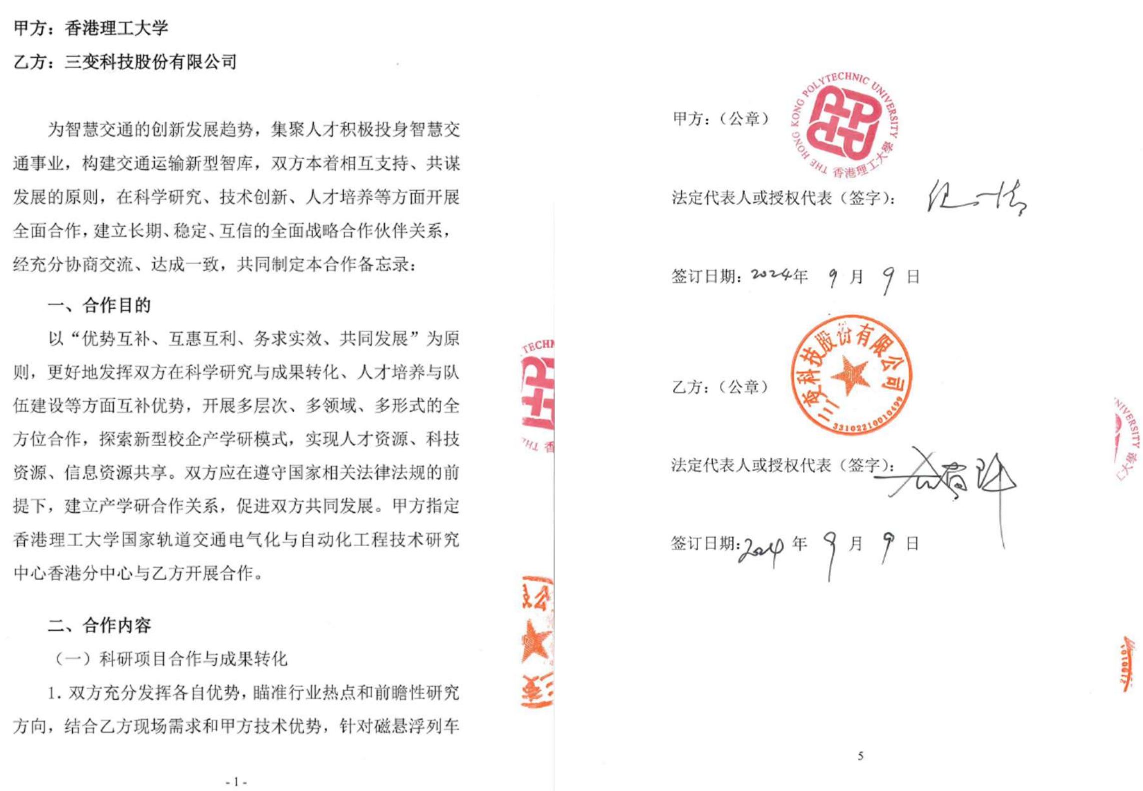
3.1.4 Cooperation Memorandum for Industry-University-Research Collaboration Signed with Zhejiang Erge Technology Joint Stock Co., Ltd.

On September 2024, the CNERC-Rail (HK Branch) signed an Industry-University-Research Cooperation Memorandum of Understanding with Zhejiang Erge Technology Joint Stock Co., Ltd. (see Fig. 3.4). To adapt to the innovative development trend of new energy and to attract talents to actively engage in the new energy sector, both parties have agreed to carry out comprehensive cooperation in scientific research, technological innovation, talent cultivation, and other aspects, and to establish a long-term, stable, and mutually trusting comprehensive strategic partnership. Both parties, after full consultation and exchange, reached a consensus and jointly formulated this Memorandum of Understanding.

Fig. 3.4 Cooperation memorandum for industry-university-research collaboration signed with Zhejiang Erge Technology Joint Stock Co., Ltd.

3.1.5 Cooperation Memorandum for Industry-University-Research Collaboration with Sanbian Sci-Tech Co., Ltd.

On September 2024, the CNERC-Rail (HK Branch) signed an Industry-University-Research Cooperation Memorandum of Understanding with Sanbian Sci-Tech Co., Ltd. (see Fig. 3.5). To align with the innovative development trends of intelligent transportation, to gather talents and encourage their active engagement in the intelligent transportation industry, and to build a new type of think tank for transportation, the two parties, adhering to the principles of mutual support and joint development, will carry out comprehensive cooperation in scientific research, technological innovation, talent cultivation and other aspects, and establish a long-term, stable, and mutually trusting comprehensive strategic partnership. Both parties, after full consultation and exchange, reached a consensus and jointly formulated this Memorandum of Understanding.



甲方：香港理工大学
乙方：三变科技股份有限公司

为智慧交通的创新发展趋势，集聚人才积极投身智慧交通事业，构建交通运输新型智库，双方本着相互支持、共谋发展的原则，在科学研究、技术创新、人才培养等方面开展全面合作，建立长期、稳定、互信的全面战略合作伙伴关系，经充分协商交流、达成一致，共同制定本合作备忘录：

一、合作目的

以“优势互补、互惠互利、务求实效、共同发展”为原则，更好地发挥双方在科学研究与成果转化、人才培养与队伍建设等方面互补优势，开展多层次、多领域、多形式的全方位合作，探索新型校企产学研模式，实现人才资源、科技资源、信息资源共享。双方应在遵守国家相关法律法规的前提下，建立产学研合作关系，促进双方共同发展。甲方指定香港理工大学国家轨道交通电气化与自动化工程技术研究中心香港分中心与乙方开展合作。

二、合作内容

（一）科研项目合作与成果转化

1. 双方充分发挥各自优势，瞄准行业热点和前瞻性研究方向，结合乙方现场需求和甲方技术优势，针对磁悬浮列车

- 1 -

甲方：（公章）

法定代表人或授权代表（签字）：

签订日期：2024年 9 月 9 日

乙方：（公章）

法定代表人或授权代表（签字）：

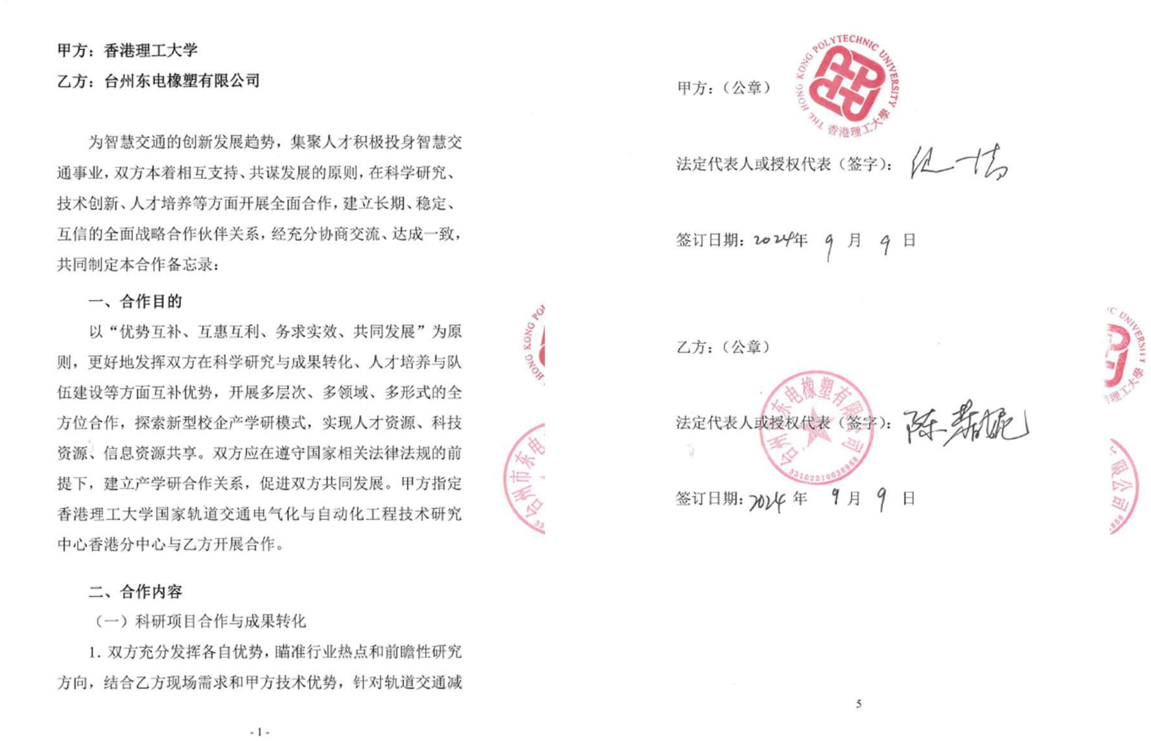
签订日期：2024 年 9 月 9 日

5

Fig. 3.5 Cooperation Memorandum for industry-university-research collaboration with Sanbian Sci-Tech Co., Ltd.

3.1.6 Cooperation Memorandum for Industry-University-Research Collaboration with Taizhou Dongdian Rubber and Plastic Co., Ltd.

On September 2024, the CNERC-Rail (HK Branch) signed an Industry-University-Research Cooperation Memorandum of Understanding with Taizhou Dongdian Rubber & Plastic Co., Ltd. (see Fig. 3.6). To align with the innovative development trends of intelligent transportation, to gather talents and encourage their active engagement in the intelligent transportation industry, and to build a new type of think tank for transportation, the two parties, adhering to the principles of mutual support and joint development, will carry out comprehensive cooperation in scientific research, technological innovation, talent cultivation and other aspects, and establish a long-term, stable, and mutually trusting comprehensive strategic partnership. Both parties, after full consultation and exchange, reached a consensus and jointly formulated this Memorandum of Understanding.



甲方：香港理工大学

乙方：台州东电橡塑有限公司

为智慧交通的创新发展趋势，集聚人才积极投身智慧交通事业，双方本着相互支持、共谋发展的原则，在科学研究、技术创新、人才培养等方面开展全面合作，建立长期、稳定、互信的全面战略合作伙伴关系，经充分协商交流、达成一致，共同制定本合作备忘录：

一、合作目的

以“优势互补、互惠互利、务求实效、共同发展”为原则，更好地发挥双方在科学研究与成果转化、人才培养与队伍建设等方面互补优势，开展多层次、多领域、多形式的全方位合作，探索新型校企产学研模式，实现人才资源、科技资源、信息资源共享。双方应在遵守国家相关法律法规的前提下，建立产学研合作关系，促进双方共同发展。甲方指定香港理工大学国家轨道交通电气化与自动化工程技术研究中心香港分中心与乙方开展合作。

二、合作内容

（一）科研项目合作与成果转化

1. 双方充分发挥各自优势，瞄准行业热点和前瞻性研究方向，结合乙方现场需求和甲方技术优势，针对轨道交通减

- 1 -

甲方：（公章）

法定代表人或授权代表（签字）：

签订日期：2024年 9 月 9 日

乙方：（公章）

法定代表人或授权代表（签字）：

签订日期：2024 年 9 月 9 日

5

Fig. 3.6 Cooperation Memorandum for industry-university-research collaboration with Taizhou Dongdian Rubber and Plastic Co., Ltd.

3.1.7 Technical Development Contract with Zhejiang Rail Transit Operation Management Group Co., Ltd., Zhejiang Haining Rail Transit Operation Management Co., Ltd., and Zhejiang Xingfu Rail Transit Operation Management Co., Ltd.

On October 2024, Southwest Jiaotong University (Party B1), East China Jiaotong University (Party B2), and the Hong Kong Polytechnic University (Party B3) signed a technical development contract with Zhejiang Rail Transit Operation Management Group Co., Ltd. (Party A1), Zhejiang Haining Rail Transit Operation Management Co., Ltd. (Party A2), and Zhejiang Xingfu Rail Transit Operation Management Co., Ltd. (Party A3) (see Fig. 3.7). Under this contract, Party A entrusts Party B to research and develop the project "Research on Health Management Technology for Key Components of Rail Vehicle Running Gear," addressing the health management needs of key components of urban rail vehicles for Zhejiang Rail Group. Addressing issues such as localized wheel non-roundness and polygonal shapes, the project aims to establish an intelligent diagnostic system for wheel non-roundness based on fiber optic grating sensing technology to evaluate the service status of wheels.

技 术 开 发 合 同 书

项目名称：轨道车辆走行部关键部件健康管理技术研究

委托方：浙江省轨道交通运营管理集团有限公司（甲方1）、
浙江海宁轨道交通运营管理有限公司（甲方2）、
浙江幸福轨道交通运营管理有限公司（甲方3）

项目第一承担单位（乙方）：西南交通大学（乙方1）
项目其他承担单位（乙方）：华东交通大学（乙方2）
香港理工大学（乙方3）

签订地点：浙江 省 杭州 市（县）
签订日期： 年 月 日
有效期限： 年 月 日至 年 月 日

浙江省轨道交通运营管理集团有限公司制

甲方1：浙江省轨道交通运营管理集团有限公司 （盖章）
法定代表人/委托代理人： （签名）
年 月 日

甲方2：浙江海宁轨道交通运营管理有限公司 （盖章）
法定代表人/委托代理人： （签名）
年 月 日

甲方3：浙江幸福轨道交通运营管理有限公司 （盖章）
法定代表人/委托代理人： （签名）
年 月 日

乙方1：西南交通大学 （盖章）
法定代表人/委托代理人： （签名）
年 月 日

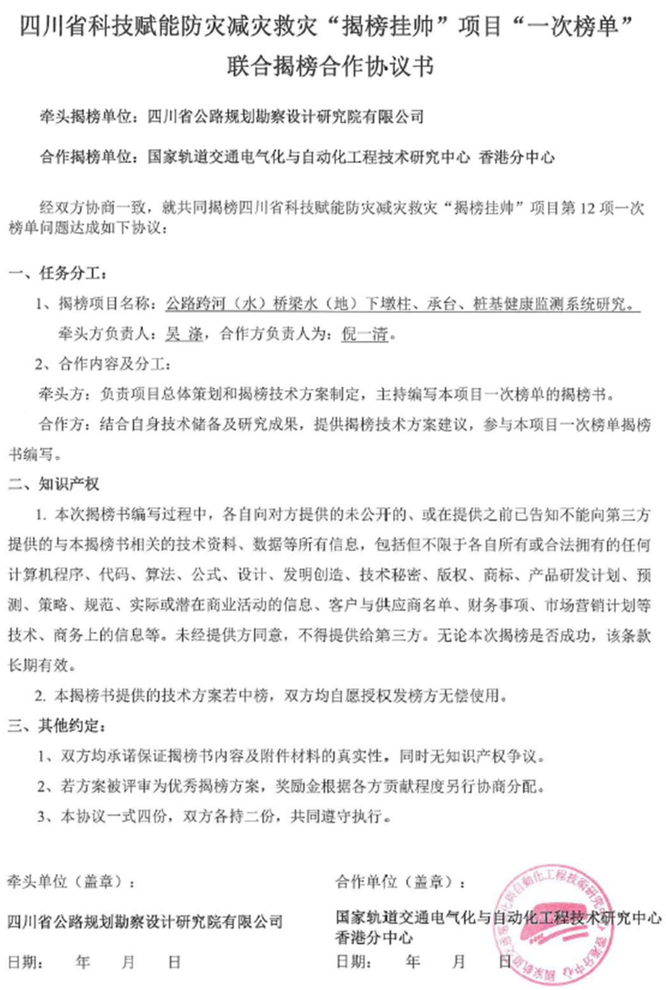
乙方2：华东交通大学 （盖章）
法定代表人/委托代理人： （签名）
年 月 日

乙方3：香港理工大学 （盖章）
法定代表人/委托代理人： （签名）

Fig. 3.7 Technical development contract with Zhejiang Rail Transit Operation Management Group Co., Ltd., Zhejiang Haining Rail Transit Operation Management Co., Ltd., and Zhejiang Xingfu Rail Transit Operation Management Co., Ltd.

3.1.8 Joint Announcement Cooperation Agreement with Sichuan Highway Planning, Survey, Design and Research Institute Ltd.

On November 2024, the CNERC-Rail (HK Branch) signed a joint announcement cooperation agreement with Sichuan Highway Planning, Survey, Design and Research Institute Ltd. for the "First List" of the Sichuan Provincial Science and Technology Empowerment for Disaster Prevention, Mitigation, and Relief "Joint Announcement" project (see Fig. 3.8). The project name is Research on Health Monitoring Systems for Underwater Piers, Bearing Platforms, and Pile Foundations of Highway Cross-River (Water) Bridges. After thorough consultation and communication, both parties reached an agreement on jointly announcing the 12th item of the "Joint Announcement" project under the Sichuan Provincial Science and Technology Empowerment for Disaster Prevention, Mitigation, and Relief, and signed this joint announcement cooperation agreement.



四川省科技赋能防灾减灾救灾“揭榜挂帅”项目“一次榜单”
联合揭榜合作协议书

牵头揭榜单位：四川省公路规划勘察设计研究院有限公司

合作揭榜单位：国家轨道交通电气化与自动化工程技术研究中心 香港分中心

经双方协商一致，就共同揭榜四川省科技赋能防灾减灾救灾“揭榜挂帅”项目第 12 项一次榜单问题达成如下协议：

一、任务分工：

1、揭榜项目名称：公路跨河（水）桥梁水（地）下墩柱、承台、桩基健康监测系统研究。

牵头方负责人：吴 涤，合作方负责人为：倪一清。

2、合作内容及分工：

牵头方：负责项目总体策划和揭榜技术方案制定，主持编写本项目一次榜单的揭榜书。

合作方：结合自身技术储备及研究成果，提供揭榜技术方案建议，参与本项目一次榜单揭榜书编写。

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2、若方案被评审为优秀揭榜方案，奖励金根据各方贡献程度另行协商分配。

3、本协议一式四份，双方各持二份，共同遵守执行。

牵头单位（盖章）：
四川省公路规划勘察设计研究院有限公司
日期： 年 月 日

合作单位（盖章）：
国家轨道交通电气化与自动化工程技术研究中心
香港分中心
日期： 年 月 日

Fig. 3.8 Joint announcement cooperation agreement with Sichuan Highway Planning, Survey, Design and Research Institute Ltd.

3.2 Conferences

3.2.1 Hosted the 2nd Workshop on Guangdong-Hongkong-Macao Greater Bay Area Maglev and Advanced Rail Transit Development

To promote technical exchanges and cooperation between maglev and advanced rail transit in the Guangdong-Hong Kong-Macao Greater Bay Area, and to explore innovative solutions to promote sustainable urban transportation development, the 2nd Guangdong-Hong Kong-Macao Grand Bay Maglev Train and Advanced Rail Transit Development Seminar was held at The Hong Kong Polytechnic University on May 24, 2024. The conference was hosted by The Hong Kong Polytechnic University and Guangdong-Hong Kong-Macao Greater Bay Area Modern Rail Transit Collaborative Innovation Centre. The topics of the conference include the development and prospect of maglev transportation, the development strategy of modern rail transportation in the Greater Bay Area, maglev transportation technology, etc.

This conference invited Academician Chun-Fang Lu, Academician Yan-Liang Du, Academician Hong-Qi Tian and Academician Chuan He for guidance and participation. Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), attended the conference as chairman of the organizing committee. Experts, scholars and industry leaders from Guangdong, Hong Kong and Macao, as well as domestic and foreign, jointly discussed the latest progress and cutting-edge research in maglev and advanced rail transit technology. Nearly 100 experts and scholars from universities and industries in Hong Kong and the Mainland attended the conference. The conference featured 1 conference report and 11 invited reports with 12 experts bringing us wonderful reports and an academic feast.

Fig. 3.9 Participants in workshop

3.2.2 Hosted the 2nd Greater Bay Area Modern Railway Transportation Technology Forum (Bay Area Forum) and the 4th Guangdong-Hong Kong-Macao Greater Bay Area Modern Railway Transportation Co-Innovation Centre Annual Conference

2024 marks the 75th anniversary of the founding of the People's Republic of China. In order to actively respond to the call of the CPC Central Committee and the State Council in the new era, continue to leverage the respective advantages of Guangdong, Hong Kong, and Macao, achieve intelligent operation and maintenance, performance improvement, and safety assurance of transportation infrastructure, and contribute to the high-quality construction and development of modern rail transit in the Guangdong-Hong Kong-Macao Greater Bay Area, the 2nd Greater Bay Area Modern Railway Transportation Technology Forum (Bay Area Forum) and the 4th Guangdong-Hong Kong-Macao Greater Bay Area Modern Railway Transportation Co-Innovation Centre Annual Conference were held at The Hong Kong Polytechnic University from May 24 to 27, 2024.

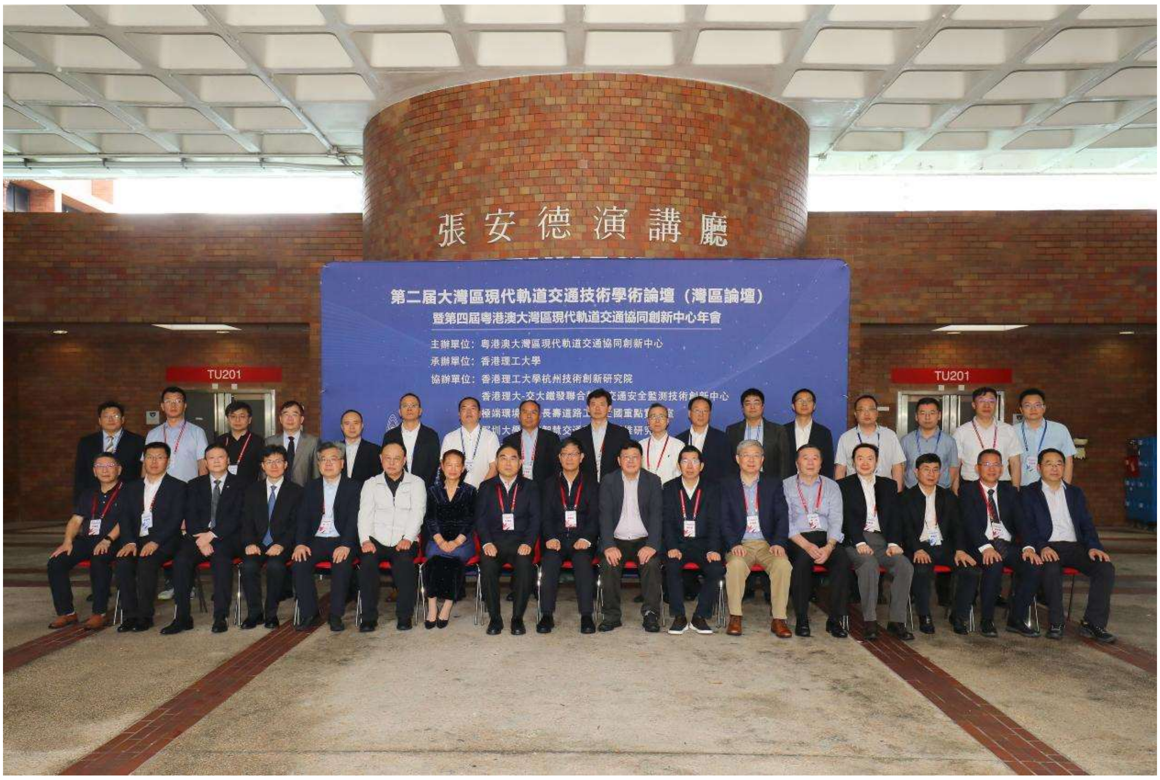


Fig. 3.10 Participants in workshop

Academician Qing-Quan Li, president of the association, and Academician Chun-Fang Lu, director of the technical committee, delivered the opening speech.

Fig. 3.11 Opening ceremonies of the forum

The conference invited more than ten academicians from the Chinese Academy of Sciences and the Chinese Academy of Engineering from various universities in China to deliver keynote reports . Academician Yan-Liang Du, Director of Collaborative Innovation Centre, made a report entitled “Annual Work Report of Modern Rail Transit Collaborative Innovation Centre in Guangdong, Hong Kong and Macao Greater Bay Area”. Academician Hong-Qi Tian of Central South University made a report entitled “Key core technology of higher-speed trains Micro-scale flow control Depth drag reduction Noise reduction”. Academician Jin-Ping Ou of Harbin Institute of Technology (Shenzhen) made a report entitled “Life Cycle Performance Monitoring of Transportation Infrastructure and Its Digital Twin”. Academician Chuan He of Southwest Jiaotong University made a report entitled “Development Prospect of Intelligent Tunnel Construction”. Academician Jian Xu of China Machinery Industry Group made a report entitled “Interpretation of Technical Standard T/CECS1234 -2023 for Double Control of Vibration and Earthquake of Building Engineering”. Mr. Xiao-Chun Zhang, Chairman of Shenzhen Smart City Science and Technology Development Group, made a report entitled “Construction Scheme of National Urban Transportation System Technology Innovation Centre”. Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), delivered a report entitled “Intelligent Rail Transit and Scientific Machine Learning”.

Fig. 3.12 Presentations by the experts

3.2.3 Hosted the Mainland-Hong Kong Frontier Forum on Intelligent Civil Engineering

To further promote the development of scientific research cooperation between universities in the Mainland and Hong Kong, and to provide a platform for to provide a platform for researchers from both regions to discuss and exchange ideas. Under the framework of the agreement between the National Natural Science Foundation of China and the Beijing-Hong Kong Academic Exchange Centre, the Hong Kong Polytechnic University held a frontier forum in Hong Kong from December 1 to 3, 2024 with the theme of Intelligent Civil Engineering. The frontier forum aimed to focus on the cutting-edge and hot issues in artificial intelligence within civil engineering, discuss the current situation and development trend of relevant research, seek in-depth cooperation on the research of frontier issues, serve the major needs of national construction, and promote the high-quality development of China's resilient cities and intelligent cities. Academician Yun-Min Chen, Academician Qing-Rui Yue, Academician Xiang-Sheng Chen, Academician Xi-Gang Zhang, Academician He-Hua Zhu and Academician Hui Li attended the frontier forum.

Fig. 3.13 Participants in the frontier forum

Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), attended the frontier forum as chairman of the organizing committee and gave a report entitled “Three Elements Driving Intelligent Structures: Smart Materials, Smart Sensing and Smart Algorithms”.

Fig. 3.14 Prof. Yi-Qing Ni’s report

3.2.4 Hosted the 2024 International Workshop on Intelligent Tropical-Storm-Resilient Systems for Coastal Cities

On August 25, 2024, The Hong Kong Polytechnic University successfully hosted the 2024 International Workshop on Intelligent Tropical-Storm-Resilient Systems for Coastal Cities. This workshop served as a significant academic platform dedicated to advancing urban resilience against tropical storms. The workshop was co-chaired by Associate Professor Xiao-Wei Deng of The University of Hong Kong, Associate Professor Meng-Qian Lu of The Hong Kong University of Science and Technology, and Associate Professor You Dong of The Hong Kong Polytechnic University. The one-day event gathered over 50 experts, scholars, and industry leaders from Hong Kong, Mainland China, and the United States. Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), extended a warm welcome to the participants in the opening ceremony.

Fig. 3.15 Participants in workshop

The workshop featured five keynote speeches. The keynote speakers were Associate Professor Sun-Wei Li from Tsinghua Shenzhen International Graduate School, Dr. E Deng from The Hong Kong Polytechnic University, Dr. Muhammad Sajjad from Hong Kong Baptist University, Dr. Zheng-Wei Chen from The Hong Kong Polytechnic University and Assistant Professor Xi-Zhong Cui from Harbin Institute of Technology, Shenzhen.

Fig. 3.16 Presentation by the experts

3.2.5 Co-organized the 6th Forum on China High-Speed Railway Health Management Technologies

The 6th Forum on China High-speed Railway Health Management Technologies was held in Nanchang from November 2 to 4, 2024. The forum was hosted by the High-Speed Railway Committee of China Railway Society, Zhantianyou Development Foundation of Science and Technology, East China Jiaotong University, and co-organized by The Hong Kong Polytechnic University, Southwest Jiaotong University and other units. In view of the frontier hot issues in the new stage of China's high-speed railway development, the forum discussed in depth the new theories, new technologies and new trends of high-speed railway health management.

Fig. 3.17 Participants in workshop

Prof. Yi-Qing Ni, director of CNERC-Rail (HK Branch), attended the forum and gave a report on "Development and thinking of health intelligent operation and maintenance technology for high-speed railway bridges". Dr. Zhi Li, a Postdoctoral Fellow and Dr. Yao Hu, a Research Associate of CNERC-Rail (HK Branch) attended the conference.

Fig. 3.18 Prof. Yi-Qing Ni's report

3.2.6 Co-organized the 1st Taishan Forum on Infrastructure Project

From July 12 to 14, 2024, the 1st Taishan Forum on Infrastructure project was held in Jinan. The forum was hosted by Shandong University, Shandong Expressway Group Co., Ltd., and co-organized by The Hong Kong Polytechnic University, Tongji University and other units. Nearly 50 academicians, national distinguished young scholars and other industry experts from domestic and overseas participated in the forum. The forum focused on the three major fields of civil engineering and transportation engineering including interdisciplinary integration and innovation, discipline transformation and upgrading, and academic frontier hotspots, so as to provide suggestions for the transformation and upgrading of discipline intelligence, digitization, and informatization.

Fig. 3.19 Participants in the Taishan Forum

Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), was invited to attend the forum and gave a special speech on "Monitoring-Based Machine Learning and Large Model Development for Transportation Infrastructure".

Fig. 3.20 Prof. Yi-Qing Ni's report

3.2.7 Attended the World Transport Convention 2024

The 2024 World Transportation Conference (WTC 2024) was held in Qingdao Cosmopolitan Exposition from June 26 to 29. The conference was jointly hosted by the China Highway and Transportation Society, China Institute of Navigation, China Railway Society, Chinese Society of Aeronautics and Astronautics, China Society of Automotive Engineers, and China Air Transport Association. With the theme of “New Transportation in Transition”, the conference covered academic exchanges, technical discussions, international cooperation, scientific and technological competitions, and results release.

Dr. Zheng-Wei Chen, a Research Assistant Professor of CNERC-Rail (HK Branch), attended the WTC 2024 and gave a presentation entitled “Aerodynamic Safety Strategies for Train Operating in Crosswind Environments: Mitigation Measures and Flow Control”.

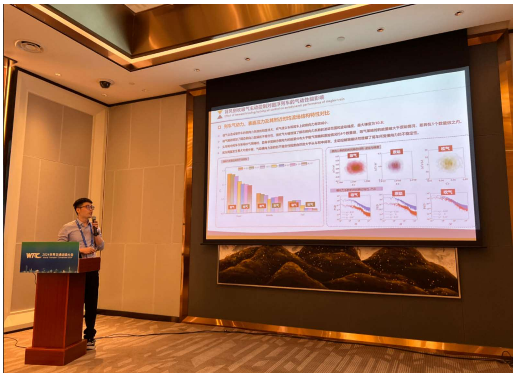


Fig. 3.21 Presentation by Dr. Zheng-Wei Chen at WTC 2024

Dr. E Deng, a Research Fellow of CNERC-Rail (HK Branch), attended the WTC2024 and gave a presentation entitled “High-speed trains/Maglev trains - Aerodynamic effects of noise barrier systems”.

Fig. 3.22 Presentation by Dr. E Deng at WTC 2024

Dr. Zi-Jiang Guo, a Postdoctoral Fellow of CNERC-Rail (HK Branch), attended the WTC2024 and gave a presentation entitled “Determination of wind turbine type for wind energy collection in railway tunnels”.

Fig. 3.23 Presentation by Dr. Zi-Jiang Guo at WTC 2024

Dr. Wen-Bo Hu, a Postdoctoral Fellow of CNERC-Rail (HK Branch), attended the WTC 2024 and gave a presentation entitled “Crack detection for BTS across complex scenarios based on digital twin and weakly supervised style transfer”.

Fig. 3.24 Presentation by Dr. Wen-Bo Hu at WTC 2024

Mr. Da-Zhi Dang, a PhD student of CNERC-Rail (HK Branch), attended the WTC2024 and gave a presentation entitled “A Guided Wave Testing Method for Railway Cracks Identification Using Optical Fiber Sensing and Orthogonal Matching Pursuit”.

Fig. 3.25 Presentation by Mr. Da-Zhi Dang at WTC 2024

Ms. Qi Zhu, a Ph. D. student of CNERC-Rail (HK Branch), attended WTC 2024. Ms. Qi Zhu gave a presentation entitled “An adaptive MADRL-HJB approach for cooperative control of nonlinear maglev suspension system”.

Fig. 3.26 Presentation by Ms. Qi Zhu at WTC 2024

3.2.8 Attended the 5th China International Congress on Composite Materials

From July 25 to 28, 2024, the 5th China International Congress on Composite Materials (CCCM-5) was successfully held in Xinjiang International Convention and Exhibition Centre. The conference was hosted by the Chinese Society for Composite Materials. The conference aimed to promote the innovation and development of composite materials in China, show the latest academic progress and innovation achievements, promote the cross-integration of related disciplines, build an international scientific and technological exchange platform, and promote efficient cooperation between industry, universities and research communities.

Dr. Si-Qi Ding, a Research Assistant Professor of CNERC-Rail (HK Branch), attended the CCCM-5 and gave a presentation entitled “Self-sensing cementitious composites with carbon nanotube-based hierarchical fillers for smart structures”.

Fig. 3.27 Presentation by Dr. Si-Qi Ding at CCCM-5

3.2.9 Attended the 12th Chinese Symposium on Magnetic Levitation Technology and Vibration Control

The 12th Chinese Symposium on Magnetic Levitation Technology and Vibration Control (CSMTVC12) was successfully held in Zhuhai, Guangdong Province from July 26 to 29, 2024. The theme of the conference was “Green and Low-Carbon, Intelligent Leadership, Magnetic Levitation Technology Support the Future of High-end Equipment”.

Dr. Su-Mei Wang, a Research Assistant Professor of CNERC-Rail (HK Branch), attended the CSMTVC12 as an invited speaker and gave a presentation entitled “Intelligent Monitoring and Control of Maglev System”.

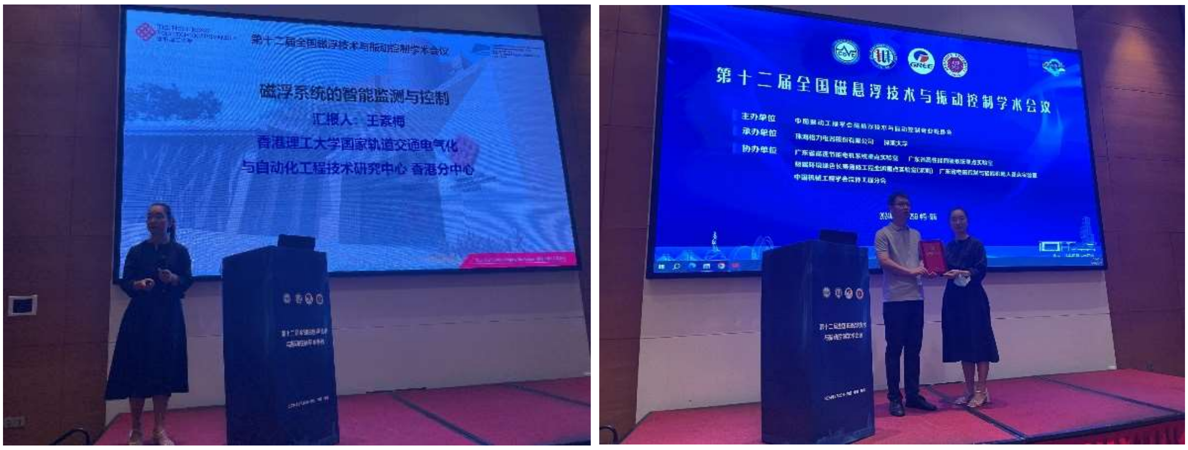


Fig. 3.28 Presentation by Dr. Su-Mei Wang at CSMTVC12

Dr. Zheng-Wei Chen, a Research Assistant Professor of CNERC-Rail (HK Branch), and Dr. Zi-Jian Guo, a Postdoctoral Fellow of CNERC-Rail (HK Branch), attended the conference and presented the wall posters of “Risk Mitigation Method for Aerodynamic Instability of Maglev Train Based on Surface Air Flow Control” and “Comparative Analysis of Aerodynamic Performance of Maglev Train and High-speed Train” respectively.

Fig. 3.29 Posters presented by Dr. Zheng-Wei Chen and Dr. Zi-Jian Guo at CSMTVC12 2024

3.2.10 Attended the 12th Cross-strait Workshop on Monitor and Control in Civil Engineering

From August 8 to 11, 2024, the 12th Cross-strait Workshop on Monitor and Control in Civil Engineering was held in Hangzhou. This conference was hosted by Hangzhou City University and China Vibration Engineering Society Structural Vibration Control and Health Monitoring Professional Committee, and organized by the Engineering College of Hangzhou City University and the College of Civil Engineering and Architecture of Zhejiang University. Professor Zhi Ding from the College of Engineering at Hangzhou City University and Professor Yuan-Feng Duan from the College of Civil Engineering and Architecture of Zhejiang University served as co-chairmen of the organizing committee. Focusing on the latest research achievements and cutting-edge trends in the field of civil engineering monitoring and control, the workshop provided a platform for researchers from both sides of the Taiwan Strait, Hong Kong and Macao to exchange ideas and share knowledge. It attracted more than 300 experts, scholars and graduate students from more than 60 universities, enterprises and institutions on both sides of the Taiwan Strait and Hong Kong and Macao to actively participate in the workshop.

Prof. Yi-Qing Ni, director of CNERC-Rail (HK Branch), attended the workshop and gave a report on “Machine Learning Methods for Structural Dynamics and Time Domain Problems”.

Fig. 3.30 Prof. Yi-Qing Ni’s report

3.2.11 Attended the World Congress on Advances in Civil, Environmental, and Materials Research 2024

“The 2024 World Congress on Advances in Civil, Environmental, and Materials Research (ACEM24)” and “The 2024 Structures Congress (Structures24)” were jointly organized in Seoul, Korea from August 19 to 22, 2024. The congress aimed to provide the first step fusion approach to solve the global problems of infrastructure, new materials, and environmental issues. Each conference of the congress was independently organized within ACEM24 in cooperation with other neighbouring conferences. The congress was a premier international forum that brought together academics and practicing engineers to exchange the frontier research results in the allied technologies under the topics of infrastructure, environmental, and materials research.

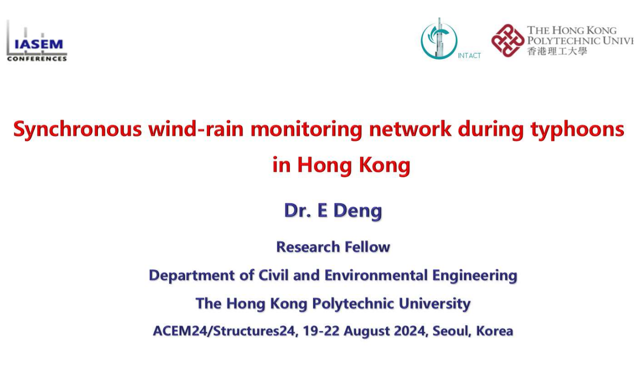
Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), attended the ACEM 2024 and delivered a report entitled “Urban Risk Mitigation of Tall Building Clusters in Coastal Cities Due to Tropical Storms”.

Fig. 3.31 Presentation by Prof. Yi-Qing Ni at ACEM 2024

Dr. Zheng-Wei Chen, a Research Assistant Professor of CNERC-Rail (HK Branch), attended the ACEM 2024 and gave a presentation entitled “Research on Safety Strategies for Rail Transit in Near-Ground Severe Wind Environments: Mitigation Measures and Flow Control”.

Fig. 3.32 Presentation by Dr. Zheng-Wei Chen at ACEM 2024

Dr. E Deng, a Research Fellow of CNERC-Rail (HK Branch), attended the ACEM2024 and gave a presentation entitled “Synchronous wind-rain monitoring network during typhoons in Hong Kong”.



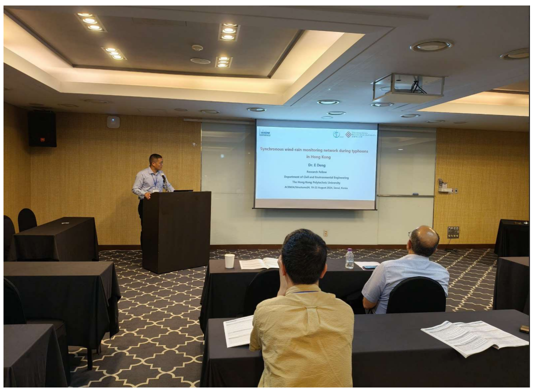


Fig. 3.33 Presentation by Dr. E Deng at ACEM 2024

Dr. Zi-Jian Guo, a Postdoctoral Fellow of CNERC-Rail (HK Branch), attended the ACEM2024 and gave a presentation entitled “Aerodynamic threat of a severe wind condition to the running safety of trains-A case study of tornados”.

Fig. 3.34 Presentation by Dr. Zi-Jian Guo at ACEM 2024

Dr. Yue Dong, a Postdoctoral Fellow of CNERC-Rail (HK Branch), attended the ACEM2024 and gave a presentation entitled “Fragility Modeling of Tall Buildings Subjected to Windborne Debris During Hurricanes”.

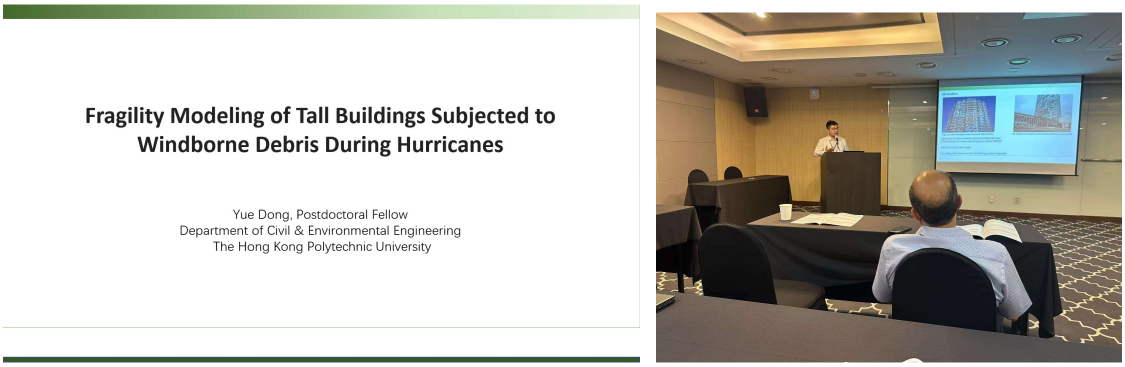


Fig. 3.35 Presentation by Dr. Yue Dong at ACEM 2024

Dr. Xiu-Yu Chen, a Research Associate of CNERC-Rail (HK Branch), attended the ACEM2024 and gave a presentation entitled “Investigation on unsteady aerodynamic forces on a rectangular section with 3:2 side ratio under accelerating airflow”.

Fig. 3.36 Presentation by Dr. Xiu-Yu Chen at ACEM 2024

Mr. Kang Cai, a Research Assistant of CNERC-Rail (HK Branch), attended the ACEM2024 and gave a presentation entitled “Nonstationary turbulent wind speed models and their effects on wind-induced responses of tall buildings”.

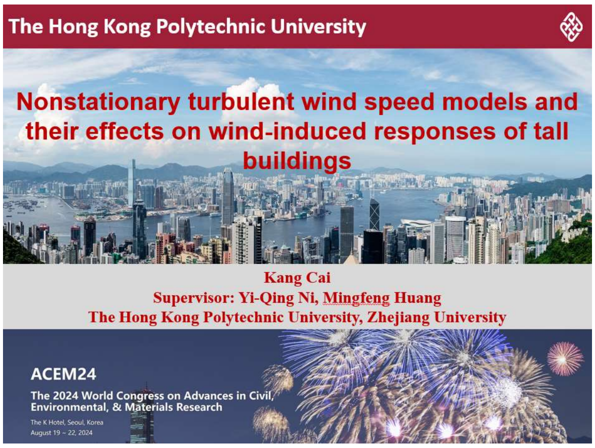


Fig. 3.37 Presentation by Mr. Kang Cai at ACEM 2024

3.2.12 Attended the 26th International Conference on Magnetically Levitated Systems and Linear Drives

The 26th International Conference on Magnetically Levitated Systems and Linear Drives (MAGLEV 2024), was held in Malmo, Sweden, September 18-22, 2024. Dr. Su-Mei Wang, a Research Assistant Professor of CNERC-Rail (HK Branch), attended the MAGLEV 2024 and gave a presentation entitled “Adaptive nonlinear control for maglev levitation system with flexible track via safe deep reinforcement learning approach”.

Fig. 3.38 Presentation by Dr. Su-Mei Wang at MAGLEV 2024

3.2.13 Attended the 10th Asia Conference on Mechanical Engineering and Aerospace Engineering

The 10th International Conference on Mechanical Engineering and Aerospace Engineering in 2024 (MEAE 2024) was held in Taicang, China from October 18 to 20, 2024.

It was hosted by Northwestern Polytechnical University and jointly organized by Civil Aviation College and Aerospace College of Northwestern Polytechnical University. This conference has created an international conference platform focusing on mechanical engineering and aerospace engineering, aiming to bring together experts, scholars and researchers in the industry, promote exchanges and cooperation between academia and industry, and jointly discuss and share the latest research achievements and cutting-edge progress on mechanical engineering and aerospace engineering.

Mr. En-Ze Rui, a PhD student of CNERC-Rail (HK Branch), gave a presentation entitled "Integration of a weak-form RANS turbulence model into PINN-based fluid simulations".

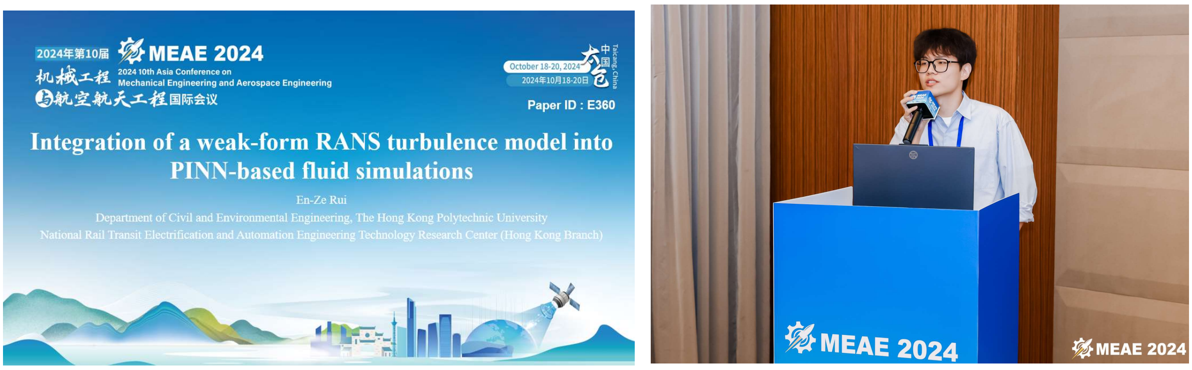


Fig. 3.39 Presentation by Mr. En-Ze Rui at MEAE 2024

3.2.14 Attended the 2nd International Conference on Smart Rail, Traffic and Transportation Engineering

The 2nd International Conference on Smart Rail, Traffic and Transportation Engineering (ICSTTE 2024) was held in Chongqing, China from October 25 to 27, 2024. ICSTTE 2024 focuses on the latest research areas of "Smart Rail, Traffic and Transportation Engineering", providing a platform for researchers, engineers, experts, scholars, and industry professionals to exchange and discuss the latest research results, and for participants to exchange new ideas and application experiences to establish business or research relationships.

Dr. Su-Mei Wang, a Research Assistant Professor of CNERC-Rail (HK Branch), attended the ICSTTE 2024, and gave a presentation entitled "Stochastic analysis of maglev train-guideway system based on Vector Form Intrinsic Finite Element Method (invited speaker)".

Fig. 3.40 Presentation by Dr. Su-Mei Wang at ICSTTE 2024

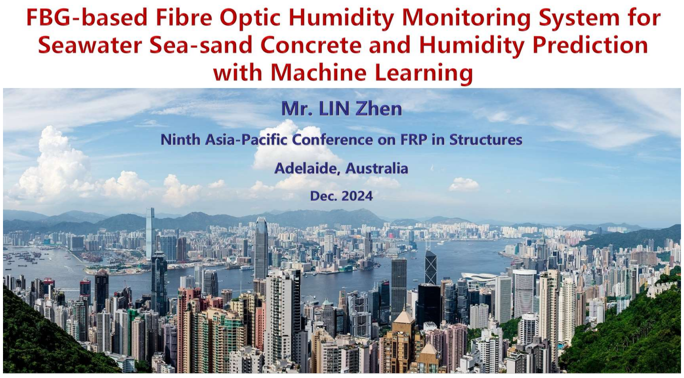
3.2.15 Attended the Ninth Asia-Pacific Conference on FRP in Structures

The Ninth Asia-Pacific Conference on FRP in Structures (APFIS 2024) was hosted by the University of Adelaide and the University of South Australia. The conference was supported by the International Institute FRP in Construction (IIFC) and was held in Adelaide from 8 to 11 December 2024.

Dr. Si-Qi Ding, a Research Assistant Professor of CNERC-Rail (HK Branch), attended the APFIS 2024 and gave a presentation entitled “Biomimetic Graphene Oxide-Layered Double Hydroxide Heterostructures for Enhanced Chloride Adsorption and Corrosion Resistance in Marine Concrete”.

Fig. 3.41 Presentation by Dr. Si-Qi Ding at APFIS 2024

Mr. Zhen Lin, a PhD student of CNERC-Rail (HK Branch), gave a presentation entitled “FBG-based Fibre Optic Humidity Monitoring System for Seawater Sea-sand Concrete and Humidity Prediction with Machine Learning”.



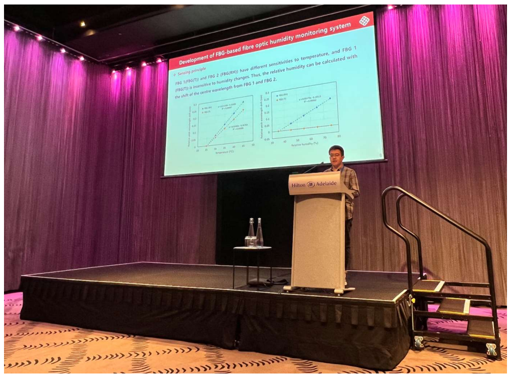


Fig. 3.42 Presentation by Mr. Zhen Lin at APFIS 2024

3.2.16 Summary of Attended Conferences

Table 3.1 Summary of attended conferences

No	Conference	Host	Venue	Time	Participants
1	The 1st Urban Safety Forum	University of Science and Technology Beijing	Beijing	2024-01-19~21	Prof. Yi-Qing Ni
2	Seventh International Workshop on Seawater Sea-sand Concrete (SSC) Structures Reinforced with FRP Composites	Southern University of Science and Technology	Shenzhen	2024-02-24	Prof. Yi-Qing Ni
3	The First Academic Exchange on Railway Operation Safety Assurance Technology	Southwest Jiaotong University	Chengdu	2024-04-12	Prof. Yi-Qing Ni
4	The 1st Sichuan-Chongqing-Hong Kong Seminar on Low-Carbon Intelligent Construction Technology	Southwest Jiaotong University	Chengdu	2024-04-13~14	Prof. Yi-Qing Ni
5	The 2024 10th International Conference on Power Electronics Systems and Applications	The Hong Kong Polytechnic University	Hong Kong	2024-06-05~07	Prof. Siu-Wing Or and Mr. Shi-Mei Chen
6	World Transport Convention 2024	China Highway and Transportation Society	Qingdao	2024-06-26~29	Dr. Zheng-Wei Chen Dr. E Deng and Dr. Zi-Jiang Guo et al.
7	The 1st Taishan Forum on Infrastructure Project	Shandong University	Jinan	2024-07-12~14	Prof. Yi-Qing Ni
8	The 5th China International Congress on Composite Materials	Chinese Society for Composite Materials	Urumqi	2024-07-25~28	Dr. Si-Qi Ding

9	The 12th Chinese Symposium on Magnetic Levitation Technology and Vibration Control	Magnetic Levitation Technology and Vibration Control Professional Committee of Chinese Society for Vibration Engineering	Zhuhai	2024-07-26~29	Dr. Su-Mei Wang, Dr. Zheng-Wei Chen and Dr. Zi-Jian Guo
10	The 12th Cross-strait Workshop on Monitor and Control in Civil Engineering	Hangzhou City University	Hangzhou	2024-08-08~11	Prof. Yi-Qing Ni
11	The Third International Conference on Rail Transportation	Tongji University	Shanghai	2024-08-10~12	Dr. Yun-fan Yang
12	The 2024 World Congress on Advances in Civil, Environmental, and Materials Research	International Association of Structural Engineering & Mechanics (IASEM)	Seoul, Korea	2024-08-19~22	Prof. Yi-Qing Ni, Dr. Zheng-Wei Chen and Dr. E Deng et al.
13	"Intersection and Fusion"-Seminar on Development Planning Strategy of Civil Engineering Discipline	Harbin Institute of Technology	Harbin	2024-08-28~29	Prof. Yi-Qing Ni
14	The 26th International Conference on Magnetically Levitated Systems and Linear Drives	Blekinge Tekniska Högskola (BTH)	Malmo, Sweden	2024-09-18~22	Dr. Su-Mei Wang
15	The 378th Shuangqing Forum	National Natural Science Foundation of China	Nanjing	2024-10-18~19	Prof. Yi-Qing Ni
16	The 10th Asia Conference on Mechanical Engineering and Aerospace Engineering	Northwestern Polytechnical University	Taicang	2024-10-18~20	Mr. En-Ze Rui
17	The 2nd International Conference on Smart Rail, Traffic and Transportation Engineering	Chongqing Jiaotong University	Chongqing	2024-10-25~27	Dr. Su-Mei Wang
18	The Tenth National Conference on Structural Vibration Control and Health Monitoring	Chinese Society for Vibration Engineering	Xiamen	2024-11-01~03	Prof. Yi-Qing Ni
19	The 6th Forum on China High-Speed Railway Health Management Technologie	East China Jiaotong University	Nanchang	2024-11-02~04	Prof. Yi-Qing Ni
20	The 2nd Academic Annual Conference on "Science, Technology Security, and Governance"	Chinese Association for Science of Science and S&T Policy Research	Zhuhai	2024-11-17~19	Prof. Yi-Qing Ni
21	The First Conference on Intelligent and Green Construction of Bridges	Southwest Jiaotong University	Chengdu	2024-11-22~24	Prof. Yi-Qing Ni
22	The Ninth Asia-Pacific Conference on FRP in Structures	University of Adelaide	Adelaide	2024-12-08~11	Dr. Si-Qi Ding and Mr. Zhen Lin

3.3 Cross Institute Technical Exchanges

3.3.1 Shenzhen Metro Group Co., Ltd.

On January 5, 2024, Prof. Yi-Qing Ni and Dr. Zheng-Wei Chen from CNERC-Rail (HK Branch), visited the Shenzhen Metro Shenyun Depot in Nanshan District and the Shenzhen Metro Science and Technology Park in Longgang District. At the Shenyun Depot, the key highlights of the visit included the fully automated testing and operation centre and the on-site vibration and noise reduction testing facilities for rail transit. The testing site comprises a low-speed section (130 meters) and a high-speed section (1.3 kilometres), with the high-speed section accommodating train speeds of up to 80 km/h, suitable for noise measurement experiments. Additionally, the test section includes a tunnel model, which effectively simulates noise propagation characteristics under various operating conditions. At the Shenzhen Metro Science and Technology Park, the team primarily visited the maintenance base of Metro Line 10, where they gained insights into the facility’s construction and operation practices.

Fig. 3.43 Prof. Yi-Qing Ni from CNERC-Rail (HK Branch) engaged in discussions with staff from Shenzhen Metro Group Co., Ltd.

3.3.2 First Management Committee Meeting on the Theme-based Research Scheme (TRS) Project “INTACT: Intelligent tropical-storm-resilient system for coastal cities”

On March 1, 2024, the first management committee meeting for the TRS project, “Intelligent Tropical Storm Disaster Reduction System for Coastal Cities,” was successfully held at The Hong Kong Polytechnic University. Project members from various institutions, including The Hong Kong Polytechnic University, City University of Hong Kong, The University of Hong Kong, The Chinese University of Hong Kong, The Hong Kong University of Science and Technology, the Hong Kong Observatory, and Arup Group Limited, attended the meeting. The meeting was chaired by Prof. You Dong from CNERC-Rail (HK Branch). Prof. Yi-Qing Ni, the centre’s director, delivered a welcome speech and introduced the project leaders, deputy leaders, and co-principal investigators to the attendees. Prof. Dong elaborated on the research gaps, significance, and overall objectives of the project, and provided a detailed overview of the four main tasks and funding allocation of the TRS project. He also discussed the expected outcomes and key milestones to ensure that all participants had a clear understanding of the project’s timeline and goals. Centre members Mr. Yuan-Jiang Zeng, Mr. Xin-Yuan Liu, Dr. Jia-Yao Wang, Dr. Yue Dong, and Dr. Wen-Bo Hu each reported on their respective research progress. The attending experts and professors offered valuable suggestions and comments on the sub-projects, further advancing the smooth development of the project.

Fig. 3.44 The first management committee meeting of the TRS project “Intelligent tropical-storm-resilient system for coastal cities” at The Hong Kong Polytechnic University

3.3.3 Sichuan Swjtu Railway Development Co., Ltd.

From April 12 to 13, 2024, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), led a delegation to visit Sichuan Swjtu Railway Development Co., Ltd. The purpose of the visit was to engage in in-depth discussions and collaborations on the implementation and advancement of two projects: "High-Speed Rail/Railway Foreign Object Intrusion Monitoring System Based on Video/Images" and "Automated Detection System for Subgrade Settlement." The delegation from CNERC-Rail (HK Branch) included Dr. Su-Mei Wang, Dr. Hong-Wei Li, and Dr. Si-Yi Chen. During the visit, the team toured the company's experimental base and engaged in detailed discussions on key project issues, further fostering cooperation between the two parties in both technology and implementation aspects.

Fig. 3.45 CNERC-Rail (HK Branch) members visited Sichuan Swjtu Railway Development Co., Ltd.

3.3.4 Arup Group Ltd.

On April 26, 2024, Dr. E Deng, Dr. Yue Dong, Dr. Xiu-Yu Chen, Dr. Wen-Bo Hu, Mr. Kang Cai, and Mr. Min Deng from CNERC-Rail (HK Branch) visited Arup Group Ltd. for a technical exchange with Dr. Xiao-Ye Yu, a member of the TRS project team. During the meeting, Dr. Yu highlighted key issues in the field investigation of glass cracks and suggested conducting experiments to explore the types and causes of the cracks. During the meeting, both parties tentatively confirmed the site selection for the planned building and discussed the related approval processes. They also determined the types of sensors to be used, laying a solid foundation for the subsequent work.

Fig. 3.46 CNERC-Rail (HK Branch) members visited Arup Group Ltd.

3.3.5 RED Wind Tunnel Laboratory

On May 9, 2024, TRS project team members from CNERC-Rail (HK Branch), including Dr. Si-Wei Liu, Dr. E Deng, Dr. Yue Dong, Dr. Xiu-Yu Chen, Dr. Jia-Yao Wang, Mr. Kang Cai, and Mr. Min Deng, visited the RED Wind Tunnel Laboratory in Shatin, Hong Kong. The wind tunnel is an open-circuit, straight-flow type, with dimensions of 5.4 meters wide, 2.2 meters high, and 25 meters long, and a maximum wind speed of 10m/ s. It is capable of measuring parameters such as wind pressure, wind load, and wind velocity on building surfaces. Following the visit to the RED Wind Tunnel Laboratory, the TRS project team from CNERC-Rail (HK Branch) decided to initiate a wind environment study for the main campus buildings of The Hong Kong Polytechnic University, particularly the Li Ka-Shing Tower. This study will combine CFD simulations, field measurements, and wind tunnel testing. The field measurements will involve installing sensors for wind pressure, wind velocity, and other parameters on the roof and facades of the Li Ka-Shing Tower, as well as deploying a LiDAR system on the rooftop to measure wind profiles. The sensor deployment on other buildings will be adjusted based on available equipment, personnel, and site conditions. Relevant wind tunnel tests will be conducted at the RED Wind Tunnel Laboratory in Shatin.

Fig. 3.47 CNERC-Rail (HK Branch) members visited the RED Wind Tunnel Laboratory.

3.3.6 Institute of Mechanics, Chinese Academy of Sciences

On May 10, 2024, Prof. Guo-Wei Yang, Prof. Di-Long Guo, Dr. Guan-Nan Zheng, Dr. Zhen-Xu Sun, Dr. Bo Yin, and Dr. Han Wu from the Institute of Mechanics, Chinese Academy of Sciences visited CNERC-Rail (HK Branch) at The Hong Kong Polytechnic University and delivered a series of academic lectures related to the operational safety of high-speed railways. Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), Dr. Zheng-Wei Chen, Dr. You-Wu Wang, Dr. Hong-Wei Li, Dr. Si-Qi Ding, and other members of CNERC-Rail (HK Branch) attended the lectures. Following the session, Prof. Ni, Dr. Chen, and other members of the CNERC-Rail (HK Branch) engaged in an in-depth discussion with the visiting delegation from the Institute of Mechanics on the future research directions and technical details.



Fig. 3.48 Technical exchange between CNERC-Rail (HK Branch) and Institute of Mechanics, Chinese Academy of Sciences

3.3.7 Prof. Qing-Quan Li's Team from Shenzhen University

On May 25, 2024, Prof. Qing-Quan Li's team from Shenzhen University visited CNERC-Rail (HK Branch). Both sides conducted in-depth technical exchanges. Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), warmly welcomed the team. The discussions focused on the advantages of inertial visual measurement technology for observing dynamic displacement responses of high-rise buildings under typhoon conditions, particularly its application in real-time monitoring. Additionally, both parties explored the method of using high-altitude balloons equipped with sensors such as temperature, humidity, anemometers, and cameras to accurately track the typhoon's path. It was mutually agreed that, with Li Ka-Shing Tower as the primary target, the two teams would collaborate on designing an installation plan for the inertial visual system to enable real-time monitoring of the building's vibration and displacement under typhoon conditions. Furthermore, the teams outlined a balloon launch plan and discussed the possibility of further engagement with the Hong Kong Observatory to seek their support.

Fig. 3.49 Prof. Qing-Quan Li's team from Shenzhen University visited CNERC-Rail (HK Branch)

3.3.8 Guangzhou University

On June 3, 2024, Prof. Yi-Qing Ni, Prof. Zhen Leng, and Dr. Si-Yi Chen from CNERC-Rail (HK Branch) visited Guangzhou University for an academic exchange. During the visit, Prof. Hai Liu's team from Guangzhou University presented their latest research progress and demonstrated ground-penetrating radar (GPR) detection equipment. The two parties engaged in in-depth discussions on the development of intelligent identification algorithms for hidden defects in subway tunnels, addressing the technical challenges and cutting-edge advancements in this field. They also explored potential future collaboration opportunities.

Fig. 3.50 CNERC-Rail (HK Branch) members visited Guangzhou University

3.3.9 IEEE P3351 and P3352 Standard Conference

On June 6, 2024, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), and Dr. Su-Mei Wang attended the revision meetings for IEEE standards P3351 and P3352. IEEE P3351 focuses on the suspension systems of electromagnetic levitation trains, while IEEE P3352 addresses the relevant specifications for short-stator magnetic levitation testing. The meeting aimed to finalize revisions for both standards. During the session, Prof. Ni and Dr. Wang provided valuable suggestions for the revision of the standards and engaged in in-depth discussions with the attending experts.

Fig. 3.51 CNERC-Rail (HK Branch) members attended conference on IEEE standards P3351 and P3352.

3.3.10 Hong Kong Observatory

On June 14, 2024, TRS project team members from CNERC-Rail (HK Branch), including Dr. E Deng, Dr. Yue Dong, Mr. Huan Yue, Mr. Xin-Yuan Liu, and Mr. Min Deng, visited the Hong Kong Observatory (HKO) for a technical exchange with Dr. Pak-Wai Chan, the Director of the HKO. The two teams finalized the data collection plan for the next phase of typhoon data and discussed the approval process for the five LiDAR measurement points. The TRS project team conducted an on-site assessment of the environmental conditions at each location and addressed power supply issues. Additionally, they summarized the technical challenges encountered during the RAMS simulation of typhoons. On August 23, 2024, further discussions were held regarding how LiDAR data could be utilized for meteorological forecasting, and the team successfully obtained all historical typhoon data associated with Hong Kong's Tropical Cyclone Warning No. 8 or above. On November 25, 2024, the TRS project team again met with Dr. Chan for another round of discussions. Dr. Chan affirmed the quality of the LiDAR data provided by the TRS project team, pointing out its positive role in the two No. 8 typhoon warning signals issued this year. Dr. Chan expressed satisfaction with the current research progress and confirmed that the Observatory would provide historical data from three Doppler weather radar systems to further support the project's research work.

Fig. 3.52 CNERC-Rail (HK Branch) members visited the Hong Kong Observatory

3.3.11 Tourism Transportation Plan Meeting for Scenic Areas

On June 16, 2024, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), and Dr. You-Wu Wang attended a meeting on the tourism transportation plan for scenic areas, held at the Shenzhen Research Institute of The Hong Kong Polytechnic University. The meeting brought together relevant personnel from Tiantai Government, CRRC Tangshan Co., Ltd., The Hong Kong Polytechnic University, and Sichuan Swjtu Railway Development Co., Ltd. Everyone conducted in-depth discussions and exchanges on transportation solutions for tourism scenic areas.

Fig. 3.53 CNERC-Rail (HK Branch) members attended tourism transportation plan meeting for scenic areas

3.3.12 Shandong University

From June 28 to 30, 2024, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), and Dr. Su-Mei Wang visited Shandong University in Jinan. During the visit, Prof. Ni and Dr. Wang visited the Qihe Laboratory and the site of the Jinan Yellow River Tunnel. They also had in-depth discussions with Prof. Li-Ping Li, Dean of the Qilu Transportation Institute at Shandong University, regarding future collaboration between both parties.

Fig. 3.54 CNERC-Rail (HK Branch) members visited Shandong University

3.3.13 Shenzhen Galaxy Twin Towers

On July 19, 2024, members of the TRS project team from CNERC-Rail (HK Branch), including Dr. E Deng, Dr. Yue Dong, and Dr. Xiu-Yu Chen, along with members of the TRS

Project Industry Committee, Dr. Jia-Hao Huang and Mr. Ying Zhong, visited the Shenzhen Galaxy Twin Towers. They engaged in detailed discussions on the structural monitoring plan with Mr. Xiao-Xiong Liao, the owner's representative, and Mr. Nong-Chao Tan, the design representative. Dr. Deng briefly introduced the TRS project and the preliminary monitoring plan, while the design team provided in-depth information on the structural design parameters of the Twin Towers. This discussion, which incorporated case studies from the Guangzhou Tower implementation and the Shenzhen SEG Tower vibration incident, focused on enhancing Galaxy Holding Group's social impact and addressing the urgent needs of the company's senior leadership. It laid the groundwork for preparing a detailed structural monitoring plan for further discussion. On November 20, 2024, the TRS project team presented the detailed monitoring technical plan to the owners' representatives of the Shenzhen Galaxy Twin Towers and further discussed the specific details of the next steps. During the meeting, the team showcased the physical appearance and dimensions of the sensors. On December 13, 2024, the TRS project team conducted a site inspection at the Shenzhen Galaxy Twin Towers, determining the installation locations and power supply solutions for the west tower's target marker, wind pressure sensors, accelerometers, and ultrasonic anemometers. The installation locations and power supply solutions for the inertial visual cameras and ultrasonic anemometers on the east tower were also finalized.

Fig. 3.55 CNERC-Rail (HK Branch) members visited Shenzhen Galaxy Twin Towers

3.3.14 Hunan Fenghuang Maglev Tourism Line Project Base

On July 20, 2024, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), Dr. You-Wu Wang, Mr. Zhong-Bin Zheng, and Dr. Su-Mei Wang accompanied a delegation from Tiantai Government, including leaders from the County Development and Reform Commission and County Tourism Investment Department, to visit the Hunan Fenghuang Maglev Tourism Line Project Base. The visit focused on understanding the construction and operation experience of maglev trains, as well as the related practices in the development of tourism in the ancient city. The following day, Prof. Ni and his team travelled to Changsha, Hunan, to inspect China’s first mid-low speed maglev commercial operation demonstration line, the Changsha Maglev Express.

Fig. 3.56 CNERC-Rail (HK Branch) members visited Hunan Fenghuang Maglev Tourism Line Project Base

3.3.15 Seminar on the Tourism Rail Transit Plan for Tiantai, Zhejiang

On July 29, 2024, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), Dr. You-Wu Wang, Mr. Zhong-Bin Zheng, and Mr. Yang Lu were invited to attend a seminar on the tourism rail transit plan for Tiantai, Zhejiang. The meeting was attended by key figures, including Chief Expert Mr. Yong-Gang Wang from CRRC Tangshan Co., Ltd., Mr. Li-Bing Qi, General Manager of CRRC Tangshan Co., Ltd. of the East China Region, Mr. Bai-Shan Xu, Deputy

Director, Mr. Liang Wang, Deputy Chief Engineer, and Project Leader Yi-Zhi Chen from the Urban Rail Transit Design Institute of China Railway Fifth Survey and Design Institute Group Co., Ltd. The Urban Rail Transit Design Institute presented the preliminary route planning and system selection strategy for the Tiantai rail transit project. Prof. Ni provided recommendations on the project's advancement strategy and next steps. All parties agreed to accelerate the preliminary preparation work in accordance with the suggestions and, if necessary, organize an expert team to conduct an on-site inspection of the project location.

Fig. 3.57 CNERC-Rail (HK Branch) members attended Seminar on the Tourism Rail Transit Plan for Tiantai

3.3.16 Zhejiang Normal University

On September 27, 2024, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), Dr. You-Wu Wang, and Mr. Zhong-Bin Zheng visited the College of Engineering at Zhejiang Normal University in Jinhua, Zhejiang. Prof. Ni delivered an academic lecture titled "Sensor Technology, Machine Learning, and the Establishment of Large Models for Intelligent Operation and Maintenance in Rail Transit." After the lecture, Prof. Ni and his team toured the university's National Rail Transit and Intelligent Manufacturing Training Base. They also held a discussion with Prof. Shi-Ju E, Dean of the College of Engineering, Prof. Xue-Ping Cui, Prof. Xin Qiu, Dr. Yi-Li Hu, and Dr. Jian-Feng Sun regarding future collaboration opportunities.

Fig. 3.58 CNERC-Rail (HK Branch) members visited Zhejiang Normal University

3.3.17 China General Nuclear Power Digital Technology Co., Ltd.

On October 15, 2024, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), was invited by Shanghai Zhongguanghe Engineering Technology Co., Ltd. to attend an exchange meeting in Shenzhen regarding the construction of high-speed maglev systems in the Guangdong-Hong Kong-Macau Greater Bay Area and the establishment of the Hong Kong Maglev Research and Development Centre. The meeting was hosted by the company, commissioned by the Hong Kong Chief Executive's Advisory Group and the Hong Kong Polytechnic University, aiming to bring together related companies and experts from the Guangzhou-Shenzhen-Hong Kong maglev industry to discuss the technological development direction and innovation mechanisms of the maglev industry. The meeting was chaired by Mr. Cheng-Ri Jin, Chief Engineer of High-Speed Maglev Project of the company. The main focus was on the development of high-speed maglev systems in the Greater Bay Area and the establishment of the Hong Kong International Maglev Research Centre. During the meeting, Prof. Ni highlighted two key points: (1) China State Railway Group Company, Ltd. and CRRC Qingdao Sifang Co., Ltd. have shown strong interest in the establishment of an international Maglev research centre in Hong Kong, with representatives visiting Hong Kong for exchange discussions; (2) Prof. Ni expressed his intention to submit a proposal to the Hong Kong Special

Administrative Region Government during the public consultation phase of the Chief Executive’s 2024 Policy Address, suggesting that the government actively integrate into the national science and technology development plan, focus on and develop maglev technology, and propose the establishment of an international maglev research centre at the Hong Kong-Macau Innovation and Technology Park to inject new momentum into Hong Kong’s technological innovation development.

3.3.18 NVIDIA HK Ltd.

On October 25, 2024, the TRS project team of CNERC-Rail (HK Branch) and the NVIDIA Artificial Intelligence Centre (AIC) had a technical exchange at the Hong Kong Polytechnic University. Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), welcomed the visit of NVIDIA and introduced the TRS project and the potential of cooperation with NVIDIA.

Fig. 3.59 NVIDIA HK Ltd. visited CNERC-Rail (HK Branch)

The TRS project team members, Dr. Jia-Yao Wang, Dr. Yue Dong, and Dr. E Deng, reported the latest progress of their projects, which involved multiscale modeling and downscaling, the destruction mechanism of glass curtain walls under tropical storms, the LiDAR system and urban building evolution. Mr. Cliff Ho from NVIDIA then gave a detailed introduction of AI and its application in the 3D industry, focusing on the application of the

Omniverse platform in digital twin technology, and discussed how to integrate AI models into 3D workflow and synthetic data generation through Omniverse. Finally, the two parties had an in-depth discussion on the possibilities of future collaborations involving the TRS project, urban climate adaptation, AI computing, CFD, and other technological perspectives, as well as the application of the Omniverse platform and tools.

3.3.19 Far East Facade (Hong Kong) Ltd.

On October 30, 2024, the TRS project team of CNERC-Rail (HK Branch) and Far East Facade (HK) Ltd. held a meeting to discuss the monitoring of glass curtain walls during typhoons. The meeting was chaired by Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), who first introduced the two teams and their respective project backgrounds, and then elaborated on the TRS project, focusing on the project's work related to tropical storms and urban resilience studies. Both sides discussed potential collaboration opportunities, particularly in the areas of structural health monitoring and curtain wall inspection. Mr. Fei Gao, General Manager of Far East Facade (HK) Ltd, emphasized the importance of installing thin film sensors on glass curtain walls for real-time monitoring and expressed a strong willingness to collaborate with the TRS project team. Prof. Ni expressed his full support for future collaboration.

Fig. 3.60 Far East Facade (Hong Kong) Ltd. visited CNERC-Rail (HK Branch)

3.3.20 Guangzhou Knowledge Tower

On November 21, 2024, the TRS project team members of CNERC-Rail (HK Branch), Dr. E Deng, Dr. Yue Dong, Dr. Xiu-Yu Chen, Ms. Ling-Yi Diao, and Mr. Min Deng, had an on-site visit and technical exchange with Mr. Hai-Bo Hong and Ms. Hui-Xia Lin, representatives of the owner and operator of the Guangzhou Knowledge Tower. Dr. Deng introduced the overview of the TRS project and the team experts and explained in detail the on-site installation of the sensor system in the Li Ka-Shing Tower. Afterward, Dr. Deng showed the sensor samples and replied to the questions about data privacy protection, news publicity, and subsequent cooperation undertakings. In addition, the project team members also conducted an on-site inspection of the top floor, refuge floor, and observation floor of the Guangzhou Knowledge Tower.

Fig. 3.61 TRS project team members of CNERC-Rail (HK Branch) visited Guangzhou Knowledge Tower

3.3.21 Sichuan Highway Planning, Survey, Design and Research Institute Ltd.

On November 25, 2024, CNERC-Rail (HK Branch) members, Dr. Zhi Li and Dr. Yao Hu, went to Sichuan Highway Planning, Survey, Design and Research Institute Ltd. and extensively investigated the research results and development status of underwater structure monitoring and inspection technology for bridges at home and abroad. They summarized four main application scenarios and demand goals for scour monitoring of bridge foundations and underwater structural disease detection technologies for Sichuan Province’s highway bridges crossing waterways: 1) Real-time monitoring and early warning of foundation scour of seasonal river-related bridges; 2) Periodic sweeping of seasonal river bed sections of seasonal river-related bridges; 3) Periodic detection of underwater structural diseases of seasonal river-related bridges; and 4) Periodic detection of underwater structural diseases of bridges in deep-water reservoir areas. For the above four application scenarios, the technical characteristics, applicable conditions, economic costs, development potential, and other advantages and shortcomings of various domestic and foreign technical methods and their equipment were analysed in depth and systematically. On this basis, research topics, technical routes, expected goals, and results forms were proposed for each of the four application scenarios. Among them, Topic I and Topic II are oriented to the seasonal river bridge foundation scour risk, for the flood season water current turbulence, high sand and gravel content, floating interference, and other harsh water conditions, respectively, plans to develop a bridge foundation local scour all-weather real-time monitoring and early warning system and a set of high-efficiency and low-cost riverbed cross-section sweeping equipment and control system. Topic III and topic IV face the bridge underwater structural disease potential, plans to develop a set of underwater structural disease detection systems applicable to seasonal river shallow water rapids and a set of underwater structural disease detection systems applicable to reservoir bridges deep water high-pressure working conditions, respectively.

Fig. 3.62 CNERC-Rail (HK Branch) members visited Sichuan Highway Planning, Survey, Design and Research Institute Ltd.

3.3.22 Line Survey for Haining Vehicle Section of Hanghai Intercity Railway

On November 28, 2024, five members from CNERC-Rail (HK Branch), Dr. Qi-Wu Zhu, Mr. Yang Lu, Mr. Qi-Fan Zhou, Mr. Guang Zhou, and Mr. Da-Zhi Dang, went to the Haining Vehicle Section of the Hangzhou-Haikou Intercity Railway to carry out the line survey work.

Fig. 3.63 CNERC-Rail (HK Branch) members at the Haining Vehicle Section of Hanghai Intercity Railway

3.3.23 China Jiliang University and General Elevator Co., Ltd.

On December 4, 2024, Dr. Qi-Bing Wang and Dr. Jia-Wei Lu from China Jiliang University, and Mr. Yue-Jiang Gu, Director and Vice President of General Elevator Co., Ltd., visited the CNERC-Rail (HK Branch). Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), Dr. You-Wu Wang, and Dr. Su-Mei Wang accompanied the visit and gave an introduction.

Fig. 3.64 CNERC-Rail (HK Branch) hosted a delegation of China Jiliang University and General Elevator Co., Ltd.

3.3.24 Shenzhen Academy of Disaster Prevention and Reduction

On December 16, 2024, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), Dr. You-Wu Wang, Dr. Su-Mei Wang, Dr. Jun-Ping Zhong, Dr. E Deng, and Dr. Yue Dong visited the Shenzhen Academy of Disaster Prevention and Reduction. They visited the industrialization projects of the Shenzhen Academy of Disaster Prevention and Reduction, including the Urban Safety Risk Monitoring and Early Warning System and the Emergency Disposal Application of Lifeline System, to learn about its latest technology and sensor monitoring equipment. During the exchange, Dr. Jun-Ping Zhong introduced the latest progress of the "Bridge Active Collision Avoidance Project", focusing on the research of real-time visual tracking algorithms for Video-AIS ships, data reception and decoding of AIS devices, ship AIS trajectory prediction, collision avoidance warning mechanism, as well as the need for cooperation in bridge field data acquisition and method validation.

Fig. 3.65 CNERC-Rail (HK Branch) members visited Shenzhen Academy of Disaster Prevention and Reduction

3.3.25 Other Technical Exchange Activities

Table 3.2 Summary of other technical exchange activities

No.	Date	Exchange with	Subject
1	2024-02-23	Southern University of Science and Technology	The Seventh International Workshop on SSC Structures Reinforced with FRP Composites
2	2024-03-25	Sichuan Swjtu Railway Development Co., Ltd.	Exchange of Cooperation Intentions
3	2024-03-26	Southwest Jiaotong University	IEEE Standard Conference
4	2024-09-10	Shenzhen Metro Group Co., Ltd.	Exchange of Cooperation Intentions
5	2024-12-17	PolyU Shenzhen Research Institute	Meeting on Preparing for the Establishment of the Hong Kong Maglev Technology and Innovation

3.4 Organized Lectures

3.4.1 Lecture by Prof. Yi-Qing Ni from Hong Kong Polytechnic University at Shantou University

On January 3, 2024, invited by the Publicity and United Front Work Department, Development Planning Department, and School of Engineering of Shantou University, Chair Prof. Yi-Qing Ni from Hong Kong Polytechnic University delivered a lecture titled "Physics-Embedded Machine Learning and Its Applications in Civil Engineering and Urban Hazard Mitigation" to faculty and students at Shantou University. He introduced the advantages, principles, and methodologies of Physics-Informed Neural Networks (PINN) in an accessible language, as well as how to use PINN to solve forward and inverse problems of partial differential equations.

Fig. 3.66 Prof. Yi-Qing Ni's lecture at Shantou University

3.4.2 Lecture by Prof. Fernando Moreu from the University of New Mexico

On January 19, 2024, invited by CNERC-Rail (HK Branch), Prof. Fernando Moreu delivered a lecture titled “New Control and Understanding of Extreme Events in the Context of Structural Dynamics”. He highlighted the ongoing global infrastructure crisis and summarized emerging approaches for infrastructure design, maintenance, and research related to structural dynamics and damage assessment.

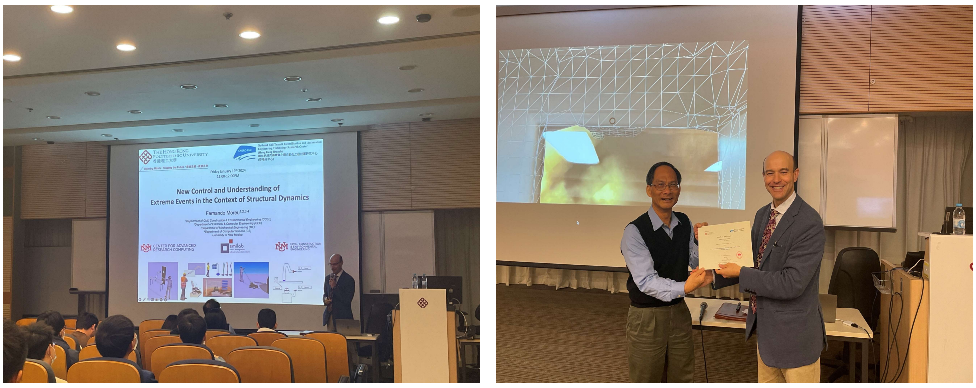


Fig. 3.67 Prof. Fernando Moreu at the lecture venue

3.4.3 Lecture by Prof. Yi-Qing Ni at the 1st Urban Safety Forum

On January 20, 2024, Prof. Yi-Qing Ni presented a lecture titled "Research on Typhoon Disaster Mitigation in Coastal Cities Based on Long-Term Monitoring and Multi-Scale Modeling" at the forum. He shared insights from Hong Kong’s first manned aircraft mission for Typhoon Saola eye-wall penetration and showcased the real-time monitoring and early warning system using a networked LiDAR system in Hong Kong.

Fig. 3.68 Prof. Yi-Qing Ni at the 1st Urban Safety Forum

3.4.4 Lecture by Prof. Aleksandar Pavic from the University of Exeter

On January 31, 2024, Prof. Aleksandar Pavic, invited by CNERC-Rail (HK Branch), delivered a lecture titled "Research and design update on vibration serviceability of building floors for 2024 and beyond". He discussed current design trends for building floors, emphasizing the challenges of ultra-lightweight floors in vibration serviceability and practical integration of Active Mass Damper (AMD) systems.

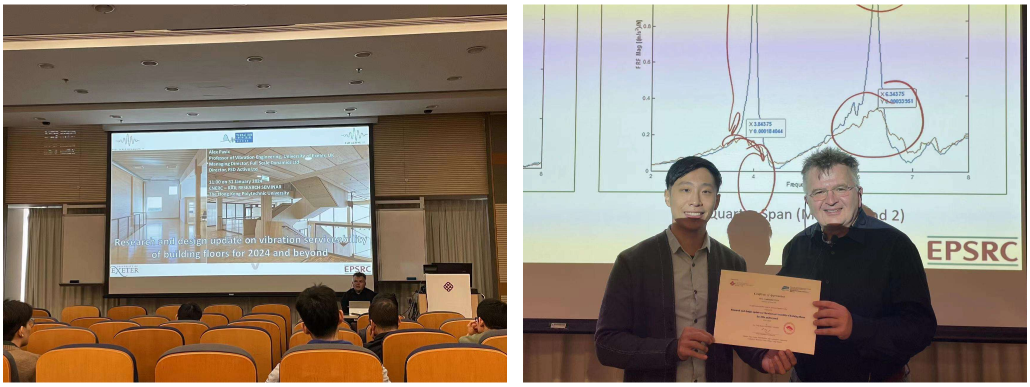


Fig. 3.69 Prof. Aleksandar Pavic at the lecture venue

3.4.5 Lecture by Prof. Werner Lienhart from Graz University of Technology

On April 16, 2024, Prof. Werner Lienhart from Graz University of Technology (Austria) visited CNERC-Rail (HK Branch) and presented a lecture titled "Static and Dynamic Bridge

Monitoring with Remote Sensing and Fiber Optic Techniques". He explored advancements in remote sensing technologies, including Distributed Fiber Optic Sensing (DFOS), interferometers, terrestrial scanners, and GNSS sensors.

Fig. 3.70 Prof. Werner Lienhart at the lecture venue

3.4.6 Lecture by Prof. Sinisa Krajnovic from Chalmers University of Technology

On May 14, 2024, Prof. Sinisa Krajnovic from Chalmers University of Technology, a leading authority in the field of fluid dynamics, visited CNERC-Rail (HK Branch). During his visit, Prof. Sinisa Krajnovic delivered a series of lectures highlighting the latest advancements in computational fluid dynamics (CFD) and its cutting-edge applications in the field of train aerodynamics. Accompanied by Dr. Huan-Feng Duan (Assistant Professor), Dr. Zheng-Wei Chen (Research Assistant Professor), Dr. Wai-Kei AO (Research Assistant Professor), Dr. Zi-Jian Guo (Postdoctoral Fellow), and other members of the centre, Prof. Sinisa Krajnovic shared insights into the forefront of CFD research and its implications for optimizing train performance. Following the lectures, Prof. Sinisa Krajnovic engaged in in-depth discussions with Prof. Duan, Dr. Chen, and others regarding future research directions and technical details.

Fig. 3.71 Prof. Sinisa Krajnovic at the lecture venue

3.4.7 Lecture by Prof. Guo Xu from Shandong University

On August 1, 2024, Prof. Guo Xu from Shandong University, invited by CNERC-Rail (HK Branch), presented a lecture titled "Computational Theories, Methods, and Applications of Nonlocal Models". She elaborated on time-varying fractional-order non-local models capable of describing multi-scale temporal memory effects.

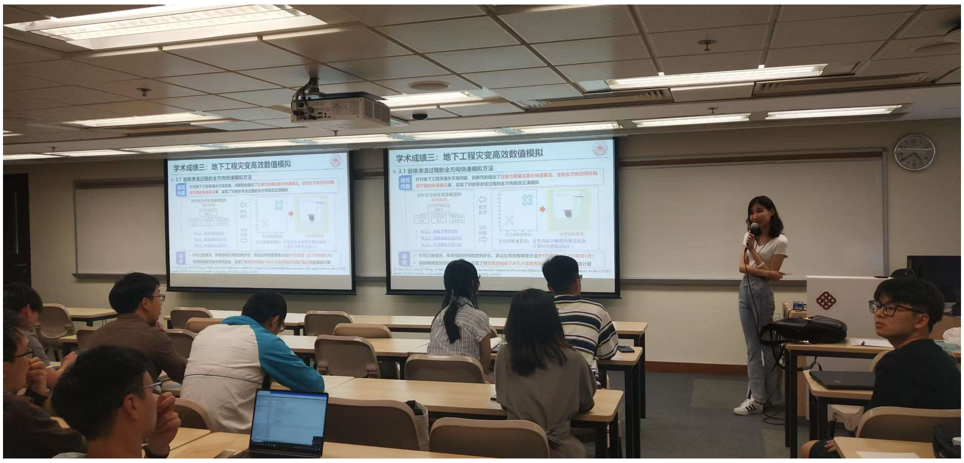


Fig. 3.72 Prof. Guo Xu at the lecture venue

3.4.8 Lecture by Prof. Hasan Özkaynak from Boğaziçi University

On September 3, 2024, Prof. Hasan Özkaynak, invited by CNERC-Rail (HK Branch), delivered a lecture titled "Developing Technologies in Precast Structures". He discussed advancements in precast structural technologies and introduced Mechanical Connectors (MCs) as robust dry connection tools for beam-column joints in prefabricated structures.

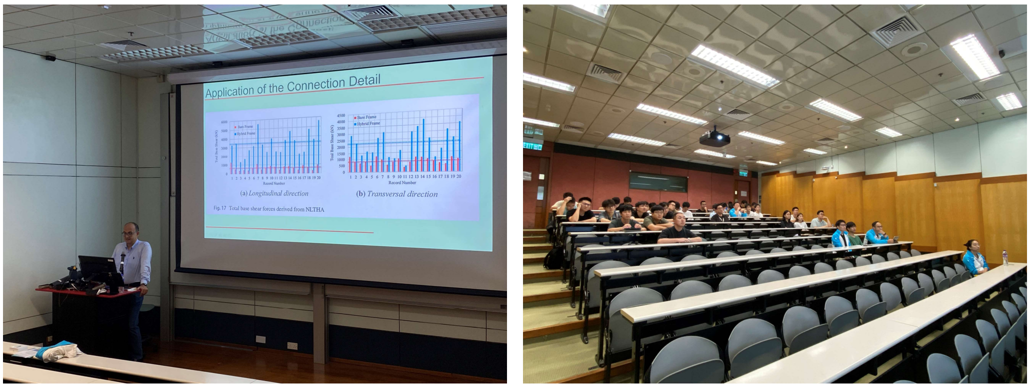


Fig. 3.73 Prof. Hasan Özkaynak at the lecture venue

3.4.9 Lecture by Prof. Fang Dongping from Tsinghua University

On October 21, 2024, Prof. Fang Dongping from Tsinghua University's School of Civil Engineering visited CNERC-Rail (HK Branch) and presented a lecture titled "People-Centric

Approach for Improving Urban Resilience". He proposed a scenario-based cross-system and cross-dimensional methodology, analysing urban resilience by conceptualizing cities as tri-space systems (physical, social, and cyber). The Quality of Life (QoL) framework was highlighted as a cornerstone for evaluating complex urban systems.

Fig. 3.74 Prof. Fang Dongping at the lecture venue

3.4.10 Lecture by Prof. Steven D. Glaser from the University of California

On October 25, 2024, Prof. Steven D. Glaser visited CNERC-Rail (HK Branch) and delivered a lecture titled "Wireless in the Woods: The Internet of Water." He introduced Wireless Sensor Networks (WSN) applications in forestry and described novel hardware and computational methods for network and sensor localization. Prof. Andy Y.F. Leung, Dr. Zhao Qi, Dr. Zhou Kai, Dr. Ding Siqi, Dr. AO Wai-Kei, and over 40 students and faculty members participated in this lecture and engaged in comprehensive discussions.

Fig. 3.75 Prof. Steven D. Glaser at the lecture venue

3.4.11 Lecture by Prof. Zhang Zhao from Beihang University

On December 11, 2024, Prof. Zhang Zhao visited CNERC-Rail (HK Branch) and presented a lecture titled "Empowering Full-Lifecycle Smart Urban Transportation with Large

Models". He introduced the research framework of Traffic GPT and emphasized the importance of interdisciplinary collaboration and mutual learning.

Fig. 3.76 Prof. Zhang Zhao at the lecture venue

3.4.12 Other Lectures

Table 3.3 Summary of other lectures

Time	Theme	Lecture	Conference	Venue
2024-04-12	Online Monitoring, Evaluation Methods, and AI Large Models for Railway Intelligent Maintenance	Prof. Yi-Qing Ni, Hong Kong PolyU	First Railway Operation Safety Assurance Technology Forum	Chengdu, China
2024-04-14	Research on Typhoon Hazard in Coastal Cities Based on Data and Large Model	Prof. Yi-Qing Ni, Hong Kong PolyU	First Sichuan-Chongqing-Hong Kong Low-Carbon Smart Construction Technology Symposium	Chengdu, China
2024-07-13	Machine Learning and Large Model Development for Monitoring-Based Transportation Infrastructure	Prof. Yi-Qing Ni, Hong Kong PolyU	First Infrastructure Engineering Taishan Forum on High-Quality Development of Modern Civil and Transportation Engineering	Jinan, China
2024-08-08	A Digital Twin Framework for Structural Inspection, Assessment and Management	Associate Prof. Guo Yanlin, Colorado State University	CNERC-Rail (HK Branch) Seminar	Hong Kong, China

3.5 Visiting Scholars & Delegations

3.5.1 Delegation from the Asian University Science and Technology Innovation Forum

On January 28, 2024, a delegation of university presidents from leading institutions in China, Japan, Singapore, Malaysia, and other Asian countries participating in the Asian University Science and Technology Innovation Forum visited the CNERC-Rail (HK Branch) (see Fig. 3.77). Dr. Wai-Kei Ao (Research Assistant Professor) and other members of the CNERC-Rail (HK Branch) warmly welcomed the delegation and introduced the centre's key research areas, latest achievements, and related research facilities.

Fig. 3.77 Delegation from the Asian University Science and Technology Innovation Forum

3.5.2 Chairman of Taizhou Municipal Committee of the Chinese People's Political Consultative Conference, Ye Haiyan

On March 2, 2024, Ms. Ye Haiyan (Chairman of the Taizhou Municipal Committee of the Chinese People's Political Consultative Conference), led a delegation to visit the CNERC-Rail (HK Branch) (see Fig. 3.78). Prof. Yi-Qing Ni, the centre's director, and Dr. You-Wu Wang (Senior Research Fellow) warmly welcomed the visiting delegation and introduced the centre's advanced maglev testing platform, leading research areas, latest achievements, and related research facilities. The delegation spoke highly of the centre's research accomplishments.

Fig. 3.78 Delegation from Taizhou municipal committee of the Chinese People's Political Consultative Conference

3.5.3 Delegation from Department of Achievement Transformation and Regional Innovation, Ministry of Science and Technology of China

On April 9, 2024, Mr. Zhou Yunfan (Director of the Department of Achievement Transformation and Regional Innovation of the Ministry of Science and Technology of China), led a delegation to visit CNERC-Rail (HK Branch) (Fig. 3.79). Prof. Yi-Qing Ni, the centre's director, provided a detailed introduction to key research achievements, including the maglev testing platform, the bogie rolling testing platform, and the three-in-one composite sustainable energy harvester. The delegation highly praised the research accomplishments of the centre. Both sides engaged in in-depth exchanges on issues such as the transformation of research achievements and engineering innovation.

Fig. 3.79 Delegation from department of achievement transformation and regional innovation, Ministry of Science and Technology of China

3.5.4 Director of Hangzhou Science and Technology Bureau, Lou Xiuhua

On May 30, 2024, Lou Xiuhua (Director of the Hangzhou Science and Technology Bureau), led a delegation to visit CNERC-Rail (HK Branch) (Fig. 3.80). Prof. Christopher Chao, Vice President (Research and Innovation) of The Hong Kong Polytechnic University, and Prof. Yi-Qing Ni, the centre's director, welcomed the delegation. Both sides engaged in discussions on issues such as the transformation of research achievements and engineering innovation.

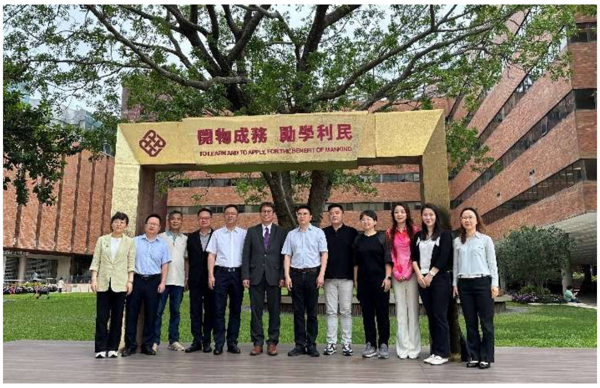


Fig. 3.80 Delegation from Hangzhou Science and Technology Bureau

3.5.5 Delegation from the Policy Unit of the Chief Executive of the Hong Kong Special Administrative Region Government

On July 22, 2024, Mr. Nicholas KWAN (Deputy Head, Chief Executive's Policy Unit) and Dr. Pamela TIN (Research Director) from the Chief Executive of the Hong Kong Special Administrative Region Government visited the CNERC-Rail (HK Branch) (Fig. 3.81). Prof. Yi-Qing Ni, Director of the centre, along with other key members, warmly welcomed the guests and provided an overview of the centre's research achievements in maglev health monitoring and control, as well as its collaborations with universities and enterprises. Mr. KWAN and Prof. Ni engaged in detailed discussions regarding the potential development of maglev transportation in Hong Kong, including how Hong Kong can contribute to the planning and development of national maglev rail transit and cultivate relevant professional talent in Hong Kong.

Fig. 3.81 Delegation from the Policy Unit of the Chief Executive of the Hong Kong Special Administrative Region Government

3.5.6 Delegation from Zhejiang's Taizhou City

On September 9, 2024, a delegation from Zhejiang's Taizhou City visited the CNERC-Rail (HK Branch) (Fig. 3.82). The delegation includes Mr. Miao Wenbin (Member of the Standing Committee of the Taizhou Municipal Committee), Mr. Zhan Hongliang (Member of the National Committee of the Chinese People's Political Consultative Conference for Hong Kong and Macao Affairs), Mr. Yu Shangqun (General Manager of Sanbian Technology Co., Ltd), Mr. Li Zhiguang (General Manager of Zhejiang Erg Technology Co., Ltd), and Ms. Chen Xinni (General Manager of Taizhou Dongdian Rubber & Plastic Co., Ltd). Witnessed by Prof. Christopher Chao, Vice President of The Hong Kong Polytechnic University, Mr. Zhan Hongliang, and Mr. Miao Wenbin, representatives from Sanbian Technology Co., Ltd., Zhejiang Erg Technology Co., Ltd., and Taizhou Dongdian Rubber & Plastic Co., Ltd. signed cooperation agreements with Prof. Yi-Qing Ni, Director of the centre.

Fig. 3.82 Delegation from Zhejiang's Taizhou city

3.5.7 Delegation from China Railway Electrification Bureau

On September 9, 2024, Mr. Wang Li (Director of the Hong Kong-Shenzhen Innovation Development Centre of the China Railway Electrification Bureau), Mr. Zhu Yonghua (Managing Director of JOINCAP Holding Group), Mr. Zhu Qijun (Manager of JOINCAP Holding Group) visited the CNERC-Rail (HK Branch) (Fig. 3.83). Dr. Wang Sumei (Research Assistant Professor) and Dr. Wai-Kei Ao (Research Assistant Professor) introduced the centre's leading research focuses, latest achievements, and related research facilities. They also discussed potential avenues for further collaboration between the two parties.

Fig. 3.83 Delegation from China Railway Electrification Bureau

3.5.8 Delegation from University Grants Committee (UGC)

On September 12, 2024, a delegation of University Grants Committee (UGC) visited the CNERC-Rail (HK Branch) (Fig. 3.84). The delegation includes Mr. Tim Lui (Chairman of UGC), 24 UGC members, and Secretariat staff. Prof. Yi-Qing Ni, Director of the centre, warmly welcomed the visiting group and provided detailed information on two ongoing research projects: "Aerodynamic Noise Control for Maglev Trains" and "Noise Control for Subway Tracks".

Fig. 3.84 Delegation from University Grants Committee (UGC)

3.5.9 Delegation from China Railway Group Limited.

On September 13, 2024, a delegation from China Railway Group Limited. visited the CNERC-Rail (HK Branch) (Fig. 3.85). Prof. Yi-Qing Ni, Director of the centre, along with Dr. You-Wu Wang (Senior Research Fellow), and Dr. Su-Mei Wang (Research Assistant Professor), Dr. Zheng-Wei Chen (Research Assistant Professor), Dr. Hong-Wei Li (Research Assistant Professor), Dr. Siqi Ding (Research Assistant Professor), and Dr. Wai-Kei Ao (Research Assistant Professor), warmly welcomed the delegation. They highlighted the centre's research advancements in areas such as "Sensors + Artificial Intelligence + Large Models", railway noise control, and maglev technology.

Fig. 3.85 Delegation from China State Railway Group Co., Ltd.

3.5.10 Delegation from Department of Science and Technology of Hunan Province

On October 15, 2024, Mr. Lai-Sheng Tong (Deputy Director of Department of Science and Technology of Hunan Province) led a delegation to visit the CNERC-Rail (HK Branch) Center (Fig. 3.86). Prof. Yi-Qing Ni, Director of the CNERC-Rail (HK Branch) Centre and Dr. Su-Mei Wang (Research Assistant Professor) introduced the relevant research in the Centre. Mr. Li-Xin Situ (Associate Director of Research and Innovation Office at Hong Kong Polytechnic University) and Ms. Rong-Jiao Zhu (Assistant Manager of Research and Innovation Office) accompanied the delegation. Both parties engaged in in-depth discussions on technological innovation and the transformation of scientific and technological achievements.

Fig. 3.86 Delegation from department of science and technology of Hunan province

3.5.11 Delegation from Department of Supervision and Scientific Integrity, Ministry of Science and Technology of China

On November 29, 2024. Mr. Guo-Qing Dai (Director of Department of Supervision and Scientific Integrity) led a delegation to visit the CNERC-Rail (HK Branch) (Fig. 3.87). Dr. Su-Mei Wang (Research Assistant Professor) warmly welcomed the delegation and introduced the centre's research and related facilities.

Fig. 3.87 Delegation from department of supervision and scientific integrity, Ministry of Science and Technology of China

3.5.12 Delegation from Shanxi Provincial Political Consultative Conference

On December 5, 2024, Mr. Yong-Hui Xue (Deputy Secretary-General of the Shanxi Provincial Political Consultative Conference) led a delegation to visit the CNERC-Rail (HK Branch) (Fig. 3.88). The delegation was warmly welcomed by Prof. Yi-Qing Ni, Director of the centre, and Dr. Wang You-Wu (Senior Research Fellow). Dr. Wang showcased the significant progress and achievements of the centre to the delegation, and the research outcomes were highly praised by the delegation.

Fig. 3.88 Delegation from Shanxi provincial political consultative conference

3.5.13 Delegation from Department of Science and Technology of Guangdong Province

On December 6, 2024, Mr. Qin-Ru Liang (Deputy Director of the Guangdong Provincial Department of Science and Technology) led a delegation to visit the CNERC-Rail (HK Branch)(Fig. 3.89). Prof. Yi-Qing Ni, Director of the centre, and Dr. Wang You-Wu (Senior Research Fellow) introduced the centre's leading research focuses, latest achievements, and related research facilities to the delegation. The research outcomes were highly praised by the guests from the Department of Science and Technology of Guangdong Province.

Fig. 3.89 Delegation from the department of science and technology of Guangdong province

3.5.14 Other Visiting Scholars & Delegations

Table 3.4 Other visiting scholars & delegations

No.	Date	Visiting Scholars & Delegations
1	2024-01-12	Delegation from Dongyang Municipal People's Government of Zhejiang Province
2	2024-02-06	Director of Chengdu Yunda Technology Co., Ltd, Mr. Zheng-Yi Liu
3	2024-03-15	Delegation from Wenzhou City
4	2024-03-15	Delegation from the Institute of Mechanics, Chinese Academy of Sciences
5	2024-07-09	Delegation from Shenzhen Academy of Disaster Prevention and Reduction, led by Jian-Tao Huang
6	2024-08-01	Delegation from China State Construction Engineering Corporation
7	2024-09-24	Delegation from Gongshu District, Hangzhou City
8	2024-09-24	Delegation from China Railway Electrification Bureau
9	2024-09-25	Delegation from the Zhejiang Provincial Science and Technology Exchange and Talent Service Centre
10	2024-10-10	Delegation from Sanmen City
11	2024-10-25	Delegation from NVIDIA AI Technology Centre, led by Simon See
12	2024-11-20	Delegation from Swiss company ELAG
13	2024-12-04	Delegation from The United Front Work Department of Linping District, Hangzhou City, led by Zi-Fa Ji
14	2024-12-04	Delegation from China Jiliang University
15	2024-12-04	Delegation from Shandong University
16	2024-12-06	Delegation from Beijing Electrification Company of China Railway Electrification Bureau, led by Yu-Bing Li
17	2024-12-12	Delegation from China Tower Group
18	2024-12-13	Delegation from Wuhan University

3.6 Media Interviews

3.6.1 Prof. Yi-Qing Ni Was the Guest Speaker at the 32nd Yangtze Forum

On the afternoon of January 3, 2024, the 32nd Yangtze forum at Shantou University was held in the auditorium of the library on the Sangpu Mountain Campus. The event was jointly organized by the Department of Party's United Front Work, the Office of Development and Planning, and the College of Engineering. This session of the forum featured a distinguished lecture by Prof Yi-Qing Ni from the Department of Civil and Environmental Engineering at The Hong Kong Polytechnic University. His talk, titled "Physics-embedded machine learning and its applications in Civil Engineering and urban disaster mitigation", was delivered to faculty and students at Shantou University. The lecture was chaired by Prof Shui-Long Shen, Dean of the School of Engineering, with attendance from Prof Ying Yu, vice dean of the School of Engineering, and Prof Zhi-Wen Zhu, director of the Department of Civil and Smart Construction Engineering.

At the beginning of the lecture, Prof. Yi-Qing Ni introduced, in clear and accessible terms, the advantages and principles of physics-informed neural networks (PINNs), as well as how PINNs can be used to solve forward and inverse problems in partial differential equations. He then discussed the challenges encountered in applying PINNs, such as solving integral-differential equations, and the solutions proposed by his research team. Finally, he shared some of the latest results achieved by his team in addressing cutting-edge engineering problems using PINNs, including the identification of rotational stiffness in semi-rigid joints, modeling of nonlinear particle dampers, as well as modeling and prediction of wind fields. Prof. Ni pointed out that coastal cities face increasing risks from typhoon disasters due to population growth and climate change. To mitigate the losses caused by typhoons, it is essential to develop an intelligent system tailored to urban environments that can effectively model wind fields and quantify risks. He aspires for this research to also benefit Shantou, a coastal city with similar characteristics.

After the lecture, a lively discussion ensued between Shantou University faculty and students and Prof. Ni on topics such as disaster alerts and early warnings, as well as the integration of physics information with machine learning. In his concluding remarks, Prof. Shen noted that Prof. Ni's combination of mathematical principles with practical engineering cases provided valuable references and profound insights for all attendees.

Fig. 3.90 Prof. Yi-Qing Ni participated in the "Yangtze Forum"

3.6.2 PolyU and Shenzhen Technology Institute of Urban Public Safety Collaborate to Build a Research Platform, Advancing Urban Safety Technology Development in Shenzhen-Hong Kong

The Hong Kong Polytechnic University (PolyU) has partnered with the National Academy of Urban Safety Development and Technology and the Shenzhen Academy of Urban Public Safety Technology to establish the Shenzhen-Hong Kong Urban Safety Technology Research Centre, aiming to drive innovative research in public safety domains. PolyU seeks to address national and industrial development priorities while strengthening international competitiveness.

The newly established centre will focus on public safety, including urban safety, industrial security, disaster prevention, and emergency management. Leveraging resources from all three institutions, it will pursue technological co-development, frontier innovation, and talent cultivation in these fields.

An inauguration ceremony was held on May 24, 2024, at the PolyU campus. Distinguished attendees included: Prof. Cheng Dong, PolyU Associate Vice President (Mainland Research Expansion); Prof. Yi-Qing Ni, Chair Professor of Smart Structures and Rail Transit; Prof. Xiao-Li Ding, Chair Professor of Geomatics; Dr. You Dong, Associate Professor of Civil and Environmental Engineering; Mr. Fang Dong, Executive Dean of the National Academy and Dean of Shenzhen Academy; Dr. Zhong-Qi Shi, Director of R&D Centre (Academician Office) at the National Academy and Shenzhen Academy.

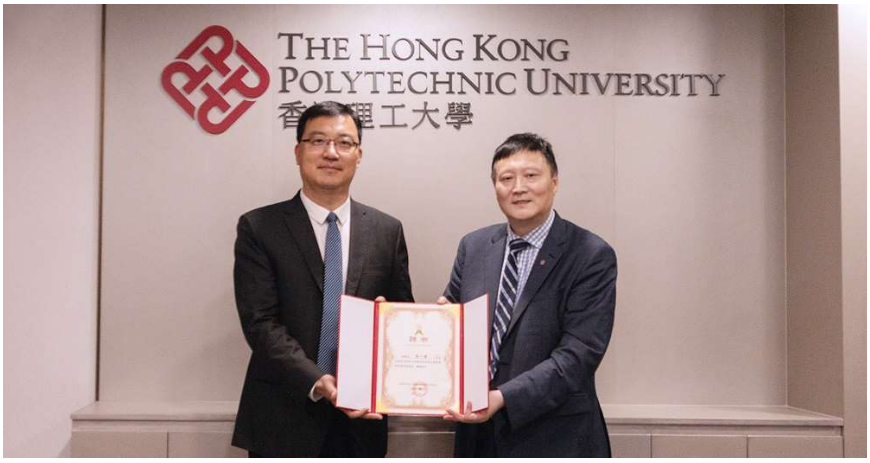


Fig. 3.91 Phot of Prof. Yi-Qing Ni, director of the CNERC-Rail (HK Branch) (right) and executive president of the National Urban Safety Institute, and Mr. Fang Dong, president of the Shenzhen Urban Safety Institute (left)

3.6.3 The Unveiling Ceremony of "Shandong Resilient and Smart Urban Transportation International Joint Laboratory"

To effectively implement the key directives of General Secretary Xi Jinping's speech during his visit to Shandong and his significant insights on Hong Kong and Macao affairs, as well as to foster high-level scientific and technological collaboration between Shandong and Hong Kong while accelerating the development of high-quality productivity, a delegation from Shandong visited Hong Kong to strengthen exchanges and cooperation. On the morning of May 28, 2004, the unveiling ceremony of the Shandong resilient and smart urban transportation international joint laboratory (hereinafter referred to as the "Laboratory") was held at the Hong Kong Science Park. The event was attended and witnessed by Mr. Wu Lin, secretary of the Shandong Provincial Party Committee; Mr. Hai-Sheng Sun, director of the Shandong Provincial Department of Science and Technology; and Mr. Qi-Feng Wang, Chairman of Shandong Hi-Speed Group. During the ceremony, the laboratory was jointly unveiled by Mr. Jun-Song Wang, Deputy Secretary of the Party Committee of Shandong University; Mr. Xiao-Dong Wang, executive director of Shandong Hi-Speed Group; Mr. Zhao-Jun Liu, Director of the Institute of Science and Technology at Shandong University; Prof. Li-Ping Li, Dean of the Qilu Institute of Transportation; Prof. Yi-Qing Ni, Chair Professor of "Intelligent Structures and Rail Transit" at The Hong Kong Polytechnic University; Prof. Sheng-Wei Wang, Director of the Institute of Smart Energy; Prof. Xiao-Lin Zhao, Deputy Director of the Institute of Land

and Space Research; and Prof. Leng Zhen, Deputy Director of the Carbon Neutral Resources Engineering Research Centre.

During the unveiling ceremony, Prof. Li-Ping Li introduced the laboratory's basic framework. The laboratory aims to meet the future needs of the smart transportation industry by developing a multi-source intelligent sensing technology system for urban roads and rail transit, building a smart decision-making system and an all-element digital twin platform, optimizing the resilience of urban transportation infrastructure, and achieving deep integration of intelligent sensing in urban transportation engineering with artificial intelligence.

Shandong University will collaborate with The Hong Kong Polytechnic University and other world-class universities to establish a leading international research cooperation hub in this field. The laboratory seeks to enhance the intelligence, digitalization, and networking capabilities of urban transportation infrastructure, achieving international leadership in intelligent diagnostic equipment, disaster intelligent decision-making and early warning systems, and urban resilience optimization for urban transportation infrastructure.

Fig. 3.92 Prof. Yi-Qing Ni, Director of the Centre, unveiling the "Shandong Resilient and Smart Urban Transportation International Joint Laboratory"

3.6.4 University Grants Committee Members Visit PolyU

A university grants committee (UGC) delegation visited PolyU on 12 September 2024, where they met with university management, faculty members and students to gain valuable insights into the University's latest developments.

Prof. Yi-Qing Ni, Yim, Mak, Kwok & Chung Professor in Smart Structures, Chair Professor of Smart Structures and Rail Transit in the Department of Civil and Environmental

Engineering, and Director of CNERC-Rail (HK Branch) shared details of two CNERC-Rail (HK Branch) research projects on aerodynamic noise resistance control for Maglev trains and metro rail noise control.

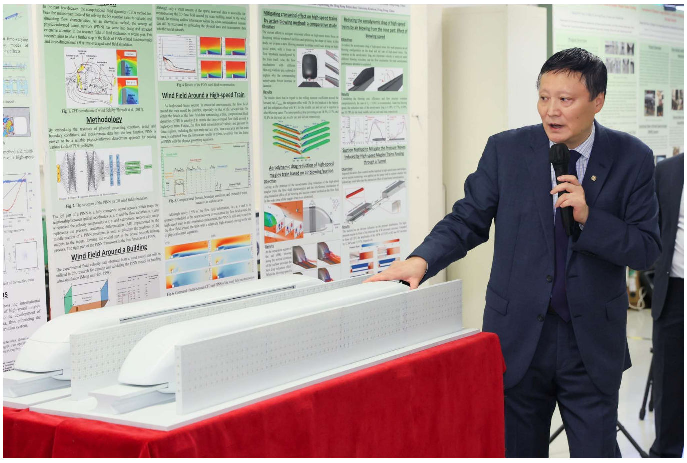


Fig. 3.93 Prof. Yi-Qing Ni shared details of two CNERC-Rail (HK Branch) research projects with the delegation: aerodynamic noise resistance control for Maglev trains and metro rail noise control.

3.6.5 The Plaque Mounting Ceremony of the "Shandong Resilient and Smart Urban Transportation International Joint Laboratory"

On December 4, 2024, the Shandong Resilient and Smart Urban Transportation International Joint Laboratory sets its focus on enhancing urban transportation resilience and promoting intelligent and safe operations. By leveraging the PolyU, a leading institution in resilient transportation infrastructure, as a key partner, the laboratory aims to drive cutting-edge interdisciplinary research and establish a new benchmark in resilient and smart urban transportation to address the challenges of sustainable urban development.

Academician Prof. Jin-Guang Teng and Academician Prof. Shu-Cai Li serve as honorary directors, while Prof. Yi-Qing Ni and Dean Prof. Li-Ping Li act as laboratory directors, jointly witnessing the plaque mounting ceremony.

This plaque mounting ceremony marks a new phase of collaboration between the two universities in the field of smart urban transportation, injecting new momentum into technological innovation and international cooperation.

Fig. 3.94 Prof. Yi-Qing Ni, Director of the Centre, jointly mounting the plaque for the "Shandong Resilient and Smart Urban Transportation International Joint Laboratory"

3.6.6 Contributing to the PolyU's 2024 Chief Executive's Policy Address

During the public consultation period for the 2024 Chief Executive's Policy Address, the Policy Research Centre for Science and Innovation (PRCSI) of the PolyU submitted a proposal to the Hong Kong Special Administrative Region (HKSAR) Government. The proposal covers four key themes: carbon-neutral cities, Hong Kong and the Greater Bay Area's collaboration in Belt and Road initiatives, and life sciences (health and medical technology).

In the proposal, Prof. Yi-Qing Ni, Director of the CNERC-Rail (HK Branch) and Dean of the PolyU Hangzhou Institute for Technology Innovation, suggested establishing an International Maglev Research Centre at the Hong Kong-Shenzhen Innovation and Technology Park. The proposal urges the HKSAR Government to actively integrate into China's national science and technology development strategy, drive the advancement of maglev technology, and establish the International Maglev Research Centre in the Hong Kong-Shenzhen Innovation and Technology Park. This initiative would inject new momentum into Hong Kong's technological innovation, support economic transformation and upgrading, enhance Hong Kong's research and development capacity and operational management expertise in the relevant fields, and strengthen Hong Kong's position on the international technology stage.

Fig. 3.95 Prof. Yi-Qing Ni, Director of the CNERC-Rail (HK Branch), proposes establishing an International Maglev Research Centre at the Hong Kong-Shenzhen Innovation and Technology Park in the Chief Executive’s Policy Address Proposal

Appendix

A.1 Equipment Purchased

A.2 News Reports

Appendix

A.1 Equipment Purchased

No.	Device/Sensor	Quantity
1	"CAMPBELL/ CR1000X" wind speed and pressure monitoring system	1
2	"Nikon" / Ti2-U fluorescence inverted microscope	1
3	"ZY-DMSIC-01" deformation monitoring system based on inertial camera vision	1
4	"航華 FR02" fast-response wind velocity measurement system	1
5	16 channels multi-input modular data acquisition (DAQ) system	1
6	AR 25A250B RF amplifier - frequency range 10KHz-250MHz, CW 25W	1
7	ATI six-axis force / torque sensor	1
8	BASLER boA1936-400cm visible light camera detection system with full software and review software for Railroad Foreign Object Intrusion	1
9	BiCAT dual rail corrugation analysis trolley	1
10	CAMPBELL CR6 data-logger with tripod and battery	1
11	Edge-cloud collaborative real-time railway monitoring platform system	1
12	Electromagnetic Shakers	1
13	Flame-T-VIS-NIR-ES FLAME-T-VIS-NIR-ES spectrometer assembly, 350-1000nm	1
14	FLS-I240-TILT forward looking multibeam sonar with cable set	1
15	HOLYWAVE RPMI-G rail profile measuring instrument [钢轨廓形（磨耗）测量仪]	1
16	Hong Kong rail transport safety meteorological warning system	1
17	Leice WindMast PBL boundary layer profile lidar system	1
18	Luna si255 fiber bragg grating (FBG) optical fiber interrogator system	1
19	Measurement specialties Initium-0000000 pressure system	1
20	NVIDIA Jetson Orin NX development kit (15pcs)	1
21	OFS GS 86545 Rayleigh scattering enhanced optical fiber for distributed acoustic sensing Note: 2,000 meters = 2,000 nos.	1

22	OTT Parsivel 2 wind-rain flow sensing system	1
23	Rail transit comprehensive operations and maintenance analysis and display system (鐵路綜合運維分析展示系統)	1
24	Sound absorption performance test for 3D printing foam concrete specimens/absorbers	1
25	Sound absorption performance test for foam concrete specimens/absorbers fabricated with different modification methods	1
26	Sound absorption performance test for foam concrete specimens/absorbers with different density	1
27	Supply of ANSYS academic research CFD (5 Tasks) and ANSYS academic research HPC workgroup 128 (Annual lease)	1
28	Syringe pumps system	1
29	Train identification system	1

A.2 News Reports

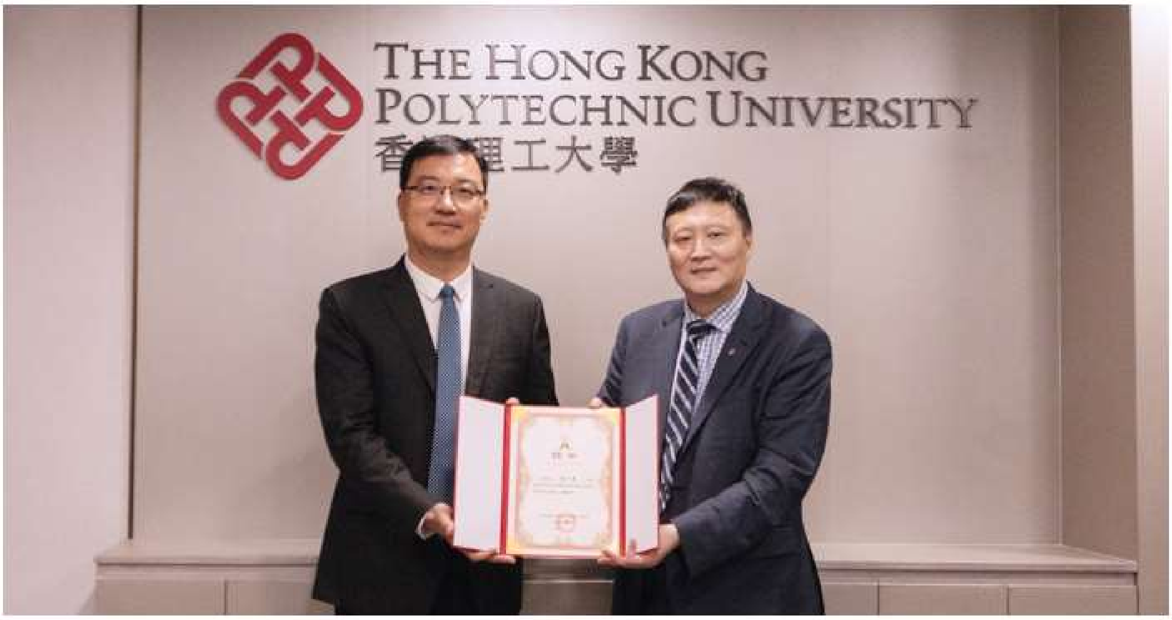
理大與深圳市城安院共建科研平台，推動深港城市安全科技發展

2024-05-27 13:47

香港理工大學（理大）與國家城市安全發展科技研究院、及深圳市城市公共安全技術研究院，合作成立深港城市安全科技研究中心，在公共安全領域開展合作創新研究。理大期望為國家及行業發展需求作出貢獻，並提升國際競爭力。

理大表示，新成立的深港城市安全科技研究中心將聚焦城市安全、安全生產、防災和應急管理等公共安全領域，並將善用三方資源開展深入合作，旨在聯合研發技術、推動前沿創新、及培育人才。

揭牌儀式於 2024 年 5 月 24 日在理大校園舉行。由理大協理副校長（內地研究拓展）董澄教授、理大智能結構與軌道交通講座教授倪一清教授、理大測繪及地理資訊學講座教授丁曉利教授、理大土木與環境工程學系副教授董優博士；與國家城安院執行院长、深圳市城安院院長董方先生、和國家城安院、深圳城安院研發中心（院士辦）主任施鍾淇博士共同見證。



“山东省韧性智慧城市交通国际联合实验室”揭牌仪式在香港举行

信息来源：　发布日期：2024-05-29　浏览量：771

为深入贯彻习近平总书记视察山东重要讲话重要指示精神和关于港澳工作的重要论述，推动鲁港高水平科技合作，加快形成新质生产力高质量发展, 山东代表团访问香港，深化鲁港两地交流合作。5月28日上午，“山东省韧性智慧城市交通国际联合实验室”（以下简称“实验室”）揭牌仪式在香港科学园隆重举行。山东省委书记林武、山东省科技厅厅长孙海生、山东高速集团董事长王其峰出席并见证实验室揭牌仪式。山东大学党委副书记王君松、山东高速集团执行总监王小东、山东大学科学技术研究院院长刘兆军、齐鲁交通学院院长李利平，香港理工大学“智能结构与轨道交通”讲座教授倪一清、智慧能源研究院院长王盛卫、土地及空间研究院副院长赵晓林、碳中和资源工程研究中心副主任冷真共同为实验室揭牌.

揭牌仪式期间，李利平向与会嘉宾介绍了实验室基本情况。实验室面向未来智慧交通产业发展需求，构建城市道路与轨道交通体系多源信息智能感知技术体系，打造智慧决策系统和全要素数字孪生平台，优化城市交通基础设施结构韧性，实现城市交通工程信息智能感知与人工智能深度融合，开展重大成果转化与工程应用示范。山东大学将联合香港理工大学等世界顶尖高校打造本领域国际一流的科研合作基地，引领城市交通基础工程领域的智能化、数字化、网络化水平提升，在城市交通基础设施领域中的智能化诊断装备、灾害智能决策预警、城市韧性优化方面达到国际领先水平。

这张照片来自一篇帖子。 查看帖子

The Hong Kong Polytechnic University - PolyU
2024年9月16日

嚴、麥、郭、鍾智能結構教授、土木及環境工程學系智能結構與軌道交通講座教授兼國家軌道交通電氣化與自動化工程技術研究中心（香港分中心）主任倪一清教授介紹其研究中心兩個科研項目，包括磁懸浮列車氣動噪聲抑控系統及地鐵路軌減振降噪系統。

Prof. Yi-qing Ni, Yim, Mak, Kwok & Chung Professor in Smart Structures, Chair Professor of Smart Structures and Rail Transit in the Department of Civil and Environmental Engineering, and Director of CNERC-Rail, shared details of two CNERC-Rail research projects with the delegation: aerodynamic noise resistance control for Maglev trains and metro rail noise control.

山东大学齐鲁交通学院
SCHOOL OF QILU TRANSPORTATION, SHANDONG UNIVERSITY

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首页 学院概况 新闻公告 师资队伍 党建标杆 人才培养 科学研究 合作交流

养等方面大力开展务实合作，致力于营造合作共赢的开放创新生态。

下午，山东大学齐鲁交通学院与香港理工大学可持续城市发展研究院联合成立的“山东省韧性智慧城市交通国际联合实验室”在香港理工大学举行挂牌仪式。

山东省韧性智慧城市交通国际联合实验室以城市交通韧性提升、智慧安全运维为目标，以联合国际韧性交通基础设施优势单位—香港理工大学为手段，推动前沿交叉学科研究，致力于打造韧性智慧城市交通新高地，应对城市可持续发展挑战。实验室由滕锦光院士和李术才院士担任实验室名誉主任，倪一清教授和李利平院长担任实验室主任，共同见证挂牌仪式。此次挂牌仪式标志着两校在智慧城市交通领域的合作进入新阶段，为推动科技创新和国际合作注入了新的动力。

此次访问活动不仅充分展现了齐鲁交通学院在土木工程智能化领域的科研实力和技术创新成果，也进一步深化了学院与香港地区高校和科研机构的合作。未来，学院将持续秉承开放合作的理念，加强与香港地区及国际同行的互动交流，共同推动土木工程智能化的发展迈向更高水平。

（2024）第 13 期

按：9 月 2 日至 9 月 8 日研究院进展及下周计划。

【本周进展】

□ **献策香港理工大学 2024 年特首《施政报告》建议书**

香港理工大学（理大）科技及创新政策研究中心于 2024 年特首《施政报告》公众咨询期间向香港特别行政区政府提交建议书，内容涵盖碳中和城市、香港及大湾区科创发展、“一带一路”合作、生命科技（健康与医疗）四大主题。港理大杭州技术创新研究院院长、轨道交通智慧中心主任倪一清教授在《施政报告》建议书中提出“在港深创新及科技园建立磁悬浮国际研究中心”。建议特区政府积极融入国家的科技发展规划，推动磁悬浮技术发展，在港深创新及科技园建立磁悬浮国际研究中心，为香港科技创新发展注入新动力，促进经济转型升级，提升香港在相关领域的科技研发储备能力和运营管理经验，助力香港在国际科技舞台上更上一层楼。


山东大学
SHANDONG UNIVERSITY
面向轨道交通智能运维的科学机器学习与大模型构建
主讲人 倪一清 教授
时间 2024年6月30日（星期日）10:00–12:00
地点 山东大学兴隆山校区齐鲁交通学院会议室
稷下风
研究生学术讲坛
2024年第38期（总第1375期）
学 科 前 沿 · 学 者 风 采
主讲人简介:
倪一清博士，教育部长江学者讲座教授，香港理工大学“严、麦、郭、钟智能结构”冠名教授，智能结构与轨道交通讲座教授，香港理工大学杭州技术创新研究院院长，国家轨道交通电气化与自动化工程技术研究中心香港分中心主任。他的研究领域涵盖结构健康监测、智能材料与结构、传感器与驱动器、贝叶斯推理与科学机器学习、高铁与磁悬浮运行安全等。倪教授发表 SCI 期刊论文 330 多篇、国际会议论文 360 多篇。学术成果在 SCI 核心合集被引用超过 10,000 次，H 指数为 54；在 Google Scholar（谷歌学术）中被引用超过 18,000 次，H 指数为 66。他是《国际结构健康监测杂志》评选的 2017 年结构健康监测年度人物奖获得者，获得国家科学技术进步二等奖、广东省科学技术进步一等奖、中国公路学会科学技术进步一等奖、中国振动工程学会科学技术进步一等奖。他亦两次获得日内瓦国际发明展金奖与特别大奖(2009、2013)。他是斯坦福大学发布的土木工程领域全球前 2% 高被引科学家（年度科学影响力和终身科学影响力）。他是 12 份国际学术期刊的联合主编、副主编、学术编辑和编委会成员。
主持人:
王利戈，山东大学齐鲁交通学院教授
主办：研究生院、党委研究生工作部
承办：山东大学齐鲁交通学院


面向轨道交通智能运维的科学机器学习与大模型构建
倪一清
香港理工大学土木及环境工程学系
国家轨道交通电气化与自动化工程技术研究中心香港分中心

National Rail Transit Electrification and Automation Engineering Technology Research Center (Hong Kong Branch)
國家軌道交通電氣化與自動化工程技術研究中心(香港分中心)

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