THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

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）

HONG KONG BRANCH OF NATIONAL RAIL TRANSIT ELECTRIFICATION AND AUTOMATION ENGINEERING TECHNOLOGY RESEARCH CENTER

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

2022 ANNUAL REPORT (ENGLISH VERSION)

CATALOGUE

Director's Foreword

On the occasion of the 25th anniversary of Hong Kong's return to the motherland in 2022, President Xi Jinping arrived at the West Kowloon High Speed Rail Station in Hong Kong by special train, bringing greetings and support from the central government to Hong Kong. As a business card of China in the new era, high-speed rail is an important link between Hong Kong and the mainland, driving the development of the Guangdong-Hong Kong-Macao Greater Bay Area (the Greater Bay Area). At present, Hong Kong, together with the motherland, is gradually getting rid of the adverse effects of the epidemic. Looking back on the past year, despite the occurrence of repeated epidemic outbreaks, the Hong Kong Branch of the National Rail Transit Electrification and Automation Engineering Technology Research Center (hereinafter referred to as "CNERC-Rail (HK Branch)"), with the joint efforts of all colleagues, has achieved fruitful results, which contribute to technological advancement in the field of railway operation safety in China and upgrading of innovative technologies for industries in Hong Kong.

The Hong Kong SAR Government released the "Hong Kong Innovation and Technology Development Blueprint" in December 2022. It proposed four major development directions and eight key strategies, including "promoting the new industrialization of Hong Kong", "making a good bridge between the mainland and the world", "strengthening the support to basic scientific research activities and facilities of universities", and "fully promoting the development of Hong Kong-Shenzhen Innovation and Technology Park in Lok Ma Chau Loop", etc. The yearly work of CNERC-Rail (HK Branch) is strongly in line with the guidelines in the Blueprint. This year, CNERC-Rail (HK Branch) actively established cooperation with universities, research institutes, enterprises and institutions to jointly apply for research and development projects, including signing a memorandum of understanding with the Mass Transit Railway Corporation Limited (hereinafter referred to as "MTR Corp Ltd"), and MTR Academy to establish partnership; signing an agreement on strategic scientific and technological innovation cooperation research projects with Southwest Jiaotong University, and jointly apply for the first batch of Hong Kong, Macao and Taiwan projects of the "strategic

scientific and technological innovation cooperation" key project in 2022; signing a cooperation agreement with Hunan Railway Vehicle Bogie Engineering Technology Research Center on conducting research on self-sensing technology and application of composite ATC antenna beam; signing a cooperation agreement on joint application for scientific research projects with Jiangsu University, focusing on the "2023 Jiangsu Science and Technology Plan Special Fund (Innovation Support Plan International Science and Technology Cooperation Hong Kong, Macao and Taiwan Science and Technology Cooperation) Project". CNERC-Rail (HK Branch) was invited to participate in the preparation of the Hong Kong Branch of the Railway Industry Engineering Research Center for Operation Safety Guarantee of the National Railway Administration and the National Center for Technological Innovation in Urban Transport Infrastructure. CNERC-Rail (HK Branch) has also actively participated in the planning of Lok Ma Chau Loop development and the construction of Hong Kong-Shenzhen Innovation and Science Park, committing itself to the research of smart railway and magnetic levitation technology and building a research base for promoting Chinese railway technology abroad, with a view to giving full play to the important role of Lok Ma Chau Loop in the development of the Greater Bay Area.

CNERC-Rail (HK Branch) has carried out in-depth research on intelligent damage detection and health assessment of rail transit, self-sensing technology, self-energy supply system of rail transit vibration power generation, maglev health monitoring and subway vibration and noise control, and is committed to adopting the innovation driven development strategies and promoting the transformation and commercialization of scientific and technological achievements. In this year, CNERC-Rail (HK Branch) completed the long-term operation monitoring of Fenghuang Maglev, the world's first "Maglev+Culture+Tourism" special line and used fiber grating sensors and accelerometers to test and analyze the stress and acceleration of the new bogie connecting bridge. The self-developed modular track particle damper has been applied on site in Shenzhen Rail Transit Line 5 and Kowloon Bay Station of Kwun Tong Line of Hong Kong Metro, and its effect on vibration and noise reduction has been evaluated. This technology has been placed in the new technology promotion catalogue of Shenzhen construction projects.

In the past year, colleagues of CNERC-Rail (HK Branch) overcame various difficulties during the epidemic and carried out series of fruitful scientific research activities, especially in high-speed railway, maglev, subway, and regional railways. In the five-year work summary report submitted to the Ministry of Science and Technology in 2022, the great achievements of

CNERC-Rail (HK Branch) were highly recognized. Finally, I would like to thank the Ministry of Science and Technology of the People's Republic of China, the Innovation and Technology Department of the Hong Kong SAR Government and the Hong Kong Polytechnic University for their strong support to our work. In the new year, CNERC-Rail (HK Branch) will keep responding to the call of the Blueprint, promote Hong Kong's “new industrialization”, actively integrate into the overall development of the country, build a bridge between the mainland and the world, and continue to make great efforts to endeavor contribution to the development of the high-speed railway in China and the world.

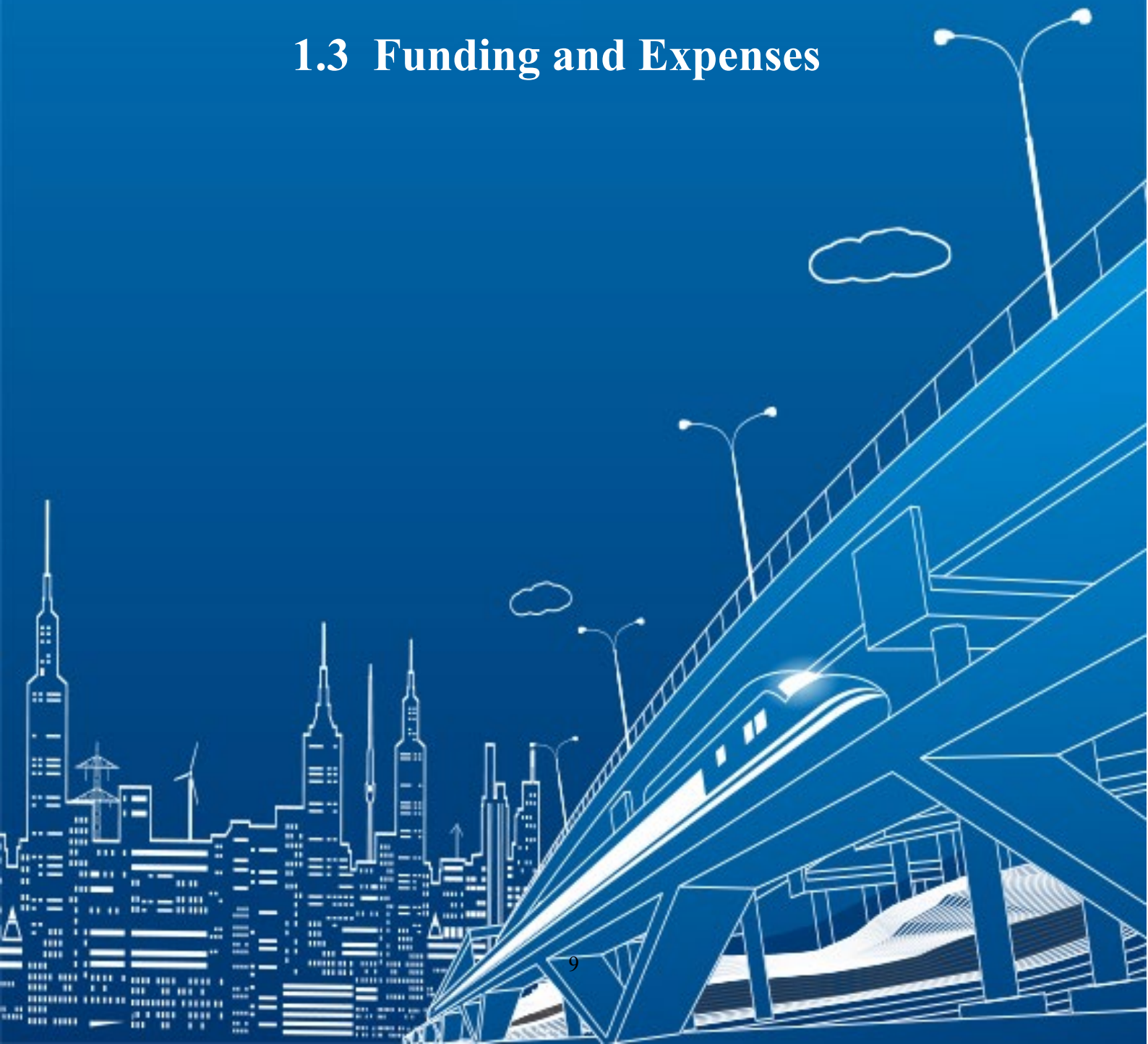
Yi-Qing NI
Chair Professor
Yim, Mak, Kwok & Chung Endowed Professorship in Smart Structures
Director of
National Rail Transit Electrification and Automation Engineering Technology Research Center (Hong Kong Branch)

1. Overview of CNERC-Rail (HK Branch) in 2022

1.1 Introduction

1.2 Research Teams

1.3 Funding and Expenses



1. Overview of CNERC-Rail (HK Branch) in 2022

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 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 analyzing techniques available in the university.

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

Vision: 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 2022 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 2022 are presented in detail in the following sections.

1.2 Research Teams

CNERC-Rail (HK Branch) consists of 11 key members (Table 1. 1) and four collaborative members (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 (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 Engineering	Deputy Director
3	Hwa-Yaw Tam, Chair Professor	Department of Electrical Engineering	Project Leader
4	Li Cheng, Chair Professor	Department of Mechanical Engineering	Project Leader
5	Jian-Nong 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 Engineering	Project Leader
8	Siu-Wing Or, Professor	Department of Electrical Engineering	Project Leader
9	Zhong-Qing Su, Professor	Department of Mechanical Engineering	Project Leader
10	Dan Wang, Professor	Department of Computing	Project Leader
11	Song-Ye 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
3	Qi Zhao, Assistant Professor	Department of Civil and Environmental Engineering	Project Leader
4	Fang-Xin Zou, Assistant Professor	Department of Aeronautical and Aviation Engineering	Project Leader

Table 1.3 Recruited staff of CNERC-Rail (HK Branch) 2022

No.	Name	Position	Period of Employment	
1	Lu Zhou	Research Assistant Professor	2020-08-01	2022-02-28
2	You-Wu Wang	Research Assistant Professor	2021-01-04	2024-06-30
3	Su-Mei Wang	Research Assistant Professor	2021-09-01	2024-06-30
4	Wai-Kei Ao	Research Assistant Professor	2022-08-29	2025-06-30
5	Zheng-Wei Chen	Postdoctoral Fellow, Research Assistant Professor	2021-09-01	2025-08-28
6	Tai-Tung Wai	Research Technical Assistant	2017-01-23	2024-01-22
7	Wing-Hong Kwan	Research Technical Assistant	2017-10-04	2024-03-31
8	Yuk Yee Chow	Research Administrative Assistant (PT)	2020-06-03	2023-06-02
9	Qiu-Hu Zhang	Postdoctoral Fellow	2021-01-05	2022-10-04

10	Chih-Shiuan Lin	Postdoctoral Fellow	2021-02-27	2022-09-01
11	Xin Cheng	Postdoctoral Fellow	2021-04-12	2022-03-31
12	Hao-Ran Zuo	Postdoctoral Fellow	2021-07-11	2022-02-28
13	Wen-Qiang Liu	Postdoctoral Fellow	2021-10-05	2023-10-05
14	Omid Hajizad	Postdoctoral Fellow	2022-03-01	2025-02-28
15	Duo Zhang	Postdoctoral Fellow	2022-05-16	2024-05-15
16	E Deng	Postdoctoral Fellow	2022-06-13	2024-06-12
17	Zi-Yu Tao	Postdoctoral Fellow	2022-07-18	2024-07-17
18	Chang-Chang Wang	Postdoctoral Fellow	2022-08-10	2024-08-09
19	Hong-Wei Li	Postdoctoral Fellow	2022-08-29	2024-08-28
20	Ying-Yu Hua	Postdoctoral Fellow	2022-09-01	2023-08-31
21	Yang Zhang	Postdoctoral Fellow	2022-11-21	2024-11-20
22	Wei Jiang	Postdoctoral Fellow	2022-12-02	2024-12-01
23	Jia-Heng Wang	Research Associate	2021-08-02	2022-01-31
24	Seyed Masoud Sajjadi Alehashem	Research Fellow	2021-09-10	2022-09-09
25	Chi-Ming Tang	Research Fellow (PT)	2022-08-01	2023-07-31
26	Ghazaleh Soltanieh	Research Associate	2021-08-23	2022-08-21

27	Chao Zhang	Research Associate	2022-02-17	2023-02-16
28	Fei-Long Lei	Research Associate (PT)	2022-07-04	2022-12-30
29	Zeng-Sheng Weng	Research Associate (PT)	2022-09-05	2023-03-03
30	Si-Xin Chen	Research Assistant, Research Associate	2021-01-18	2022-06-04
31	Yun-Ke Luo	Research Assistant, Research Associate	2022-01-03	2023-01-02
32	Yang Lu	Research Assistant	2021-04-01	2023-04-01
33	Yu-Ling Wang	Research Assistant	2021-04-14	2023-04-15
34	Si-Yuan Guo	Research Assistant	2021-07-22	2022-01-21
35	Qi-Fan Zhou	Research Assistant	2021-08-21	2023-08-20
36	Qi Zhu	Research Assistant	2021-08-23	2022-02-21
37	Bei-Yang Zhang	Research Assistant	2021-09-01	2022-08-28
38	Qiu-Han Meng	Research Assistant	2021-09-01	2022-03-31
39	Yuan-Man Zhang	Research Assistant	2021-10-01	2022-04-30
40	Long-Hin Man	Research Assistant	2021-11-01	2022-04-30
41	Zi-Mo Zhu	Research Assistant	2022-01-03	2023-12-21
42	Lin-Lin Cai	Research Assistant	2022-01-04	2023-01-03
43	Xuan Zhang	Research Assistant	2022-02-21	2022-08-31

44	Guang-Zhi Zeng	Research Assistant	2022-05-03	2023-10-27
45	Sheng-Yuan Liu	Research Assistant	2022-05-25	2023-11-24
46	Yuan-Hao Wei	Research Assistant	2022-07-03	2023-01-02
47	Jun-Shu Zhou	Research Assistant	2022-07-12	2023-07-11
48	Han-Zhang Lu	Research Assistant	2022-08-01	2023-04-30
49	Si-Yi Chen	Research Assistant	2022-09-01	2023-02-28
50	Zhan-Hao Guo	Research Assistant	2022-09-01	2023-02-28
51	Zhen-Xin Che	Research Assistant	2022-09-01	2023-02-28
52	Yu-Xuan Liang	Research Assistant	2022-11-07	2023-05-06
53	Zhen-Bin Zhou	Research Assistant	2022-12-06	2023-11-30
54	Yang Song	Research Assistant (PT)	2021-09-16	2023-04-30
55	Zi-Lin Li	Research Assistant (PT)	2021-12-01	2022-02-28
56	Chi-Shing Liu	Research Assistant (PT)	2022-03-01	2023-02-28
57	Yiu-Man Yip	Research Assistant (PT)	2022-08-01	2023-07-31
58	Kee-Yuen Lam	Project Assistant (PT)	2022-10-15	2023-10-16

1.3 Funding and Expenses

General breakdown for 2022:

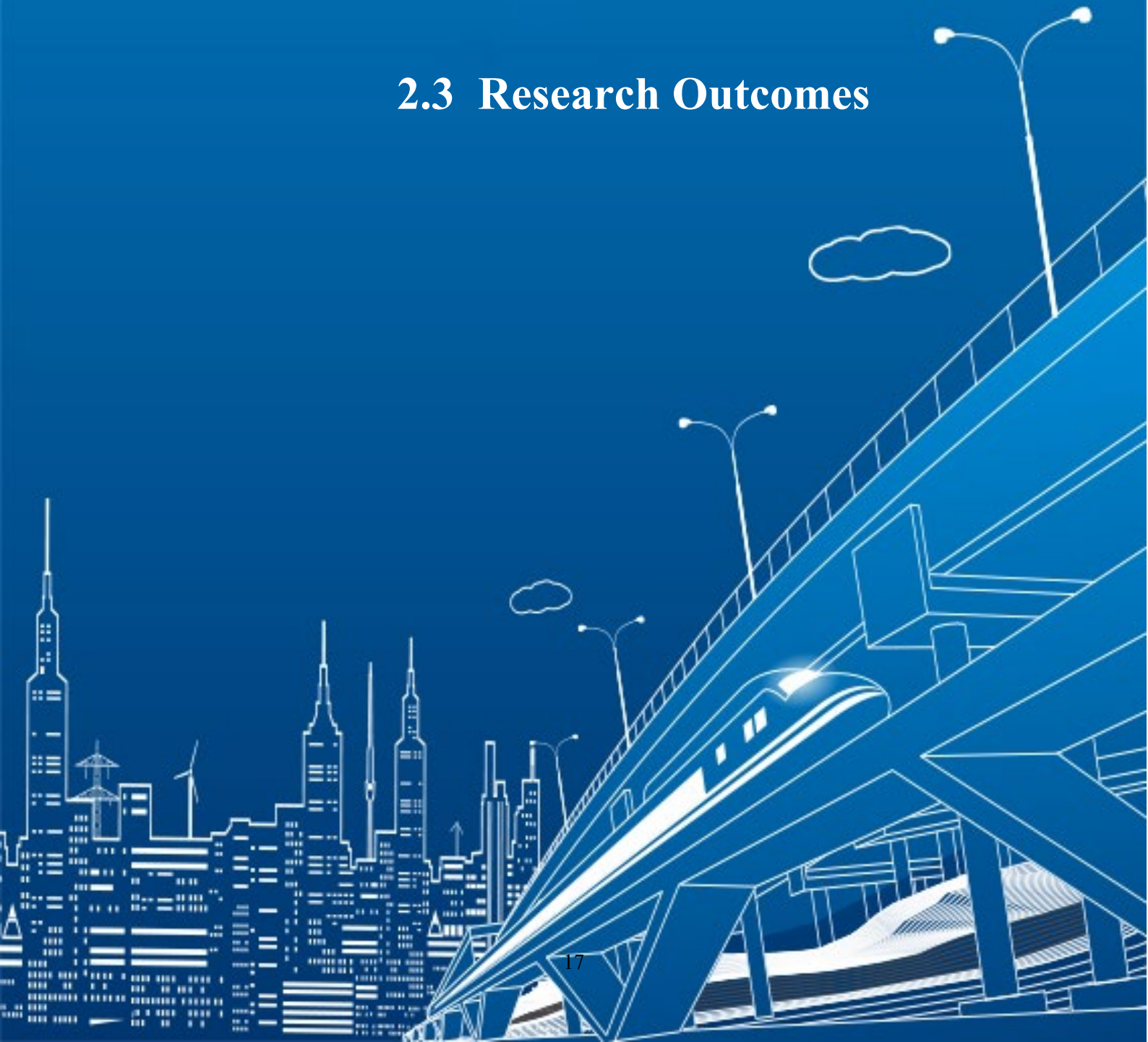
1. Income: 25,000,000 HK Dollars		
	ITC Funding	$20,000,000.00
	PolyU Funding	$5,000,000.00
2. Expenses: 25,000,000 HK Dollars		
	Research Projects	$7,533,333.00
	Human Resource	$4,101,267.00
	Equipment Purchase	$12,201,928.18
	General Expenses	$1,163,471.82

2. R&D Activities

2.1 Research Projects

2.2 Research Progress

2.3 Research Outcomes



2. R&D Activities

2.1 Research Projects

2.1.1 Research Grants Applications

In 2022, CNERC-Rail (HK Branch) has applied for, by itself or jointly with partners, 12 research grants in Hong Kong and the mainland, among which 9 have been approved providing total funding of around 11.1 million HKD. The remaining 3 applications are still being processed. The funding schemes include a theme-based research scheme under the Research Grants Council (RGC) of the Hong Kong SAR Government, various international/Hong Kong-Macau-Taiwan collaborative scheme under different levels of 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 2022

No.	Title	Funding Source	Amount	Status
1	Engineering an Integrated Wireless Sensing System for High-speed Trains: System Design and Field Test	Project of Strategic Importance, The Hong Kong Polytechnic University (2021/22)	HKD 1,900,000	Approved
2	A World of IoT Opportunity for Smart Railway Development: Reliability-oriented Wireless Sensing for Monitoring and Management of Intelligent Railway Vehicles	Hong Kong Research Grants Council, Research Impact Fund (2022/23)	HKD 6,000,000	Pending
3	3D wireless power transfer and energy storage project to robotic bat development for bionic and electric mobility technologies	General Research Fund, HKSAR 2022	HKD 925,000	Approved
4	Development of fixed-route autonomous driving for light vehicles with smart steering and enhanced power regeneration - the ultimate solution for smart steering and smart energy management	Innovation and Technology Fund - Automative Platforms and Application Systems R&D Centre (ITF-APAS) 2022	HKD 4,260,000	Approved
5	Coupling investigation of wireless power transfer for super high speed vehicles	General Research Fund, HKSAR 2023	HKD 1,002,000	Approved

6	Intelligent monitoring and health assessment system based on visual representation and in-situ perception for the high-speed railway catenary	Mainland-Hong Kong Joint Funding Scheme, Platform	HKD 2,699,000	Pending
7	Mechanism of Wind Load Reduction by Surface Blowing/Suction Method for High-speed Trains and Optimization Strategy under Wind Environment	National Natural Science Foundation of China	CNY 300,000	Approved
8	Research on The Generalization of The Localization Model of The Components of The Catenary Support Device on Different Lines of The High-speed Railway	National Natural Science Foundation of China	CNY 300,000	Approved
9	Study on pitting growth conditions of stainless steel based on four-dimensional ultrasonic imaging technology	National Natural Science Foundation of China	CNY 300,000	Approved
10	Study on Dynamic Characteristics of Fluid-structure Interaction and Active and Passive Cooperative Control of Maglev Train under Unsteady Aerodynamic Loads	Hong Kong-Macau Collaborative Research Fund, Wuyi University	CNY 500,000	Approved
11	Development of a Modular Rail Damper Based on Particle Damping Technology for Controlling Rail Corrugation Growth and Broadband Rolling Noise in Railways	Innovation and Technology Fund	HKD 1,399,800	Approved
12	Intact: Intelligent tropical-storm-resilient system for coastal cities	Hong Kong Research Grants Council Theme-based Research Scheme 2023/24 (Thirteenth Round)	HKD 5010.50	Pending

2.1.2 Established Research Projects

In 2022, CNERC-Rail (HK Branch) has newly established and carried out a total of 16 research projects, including 11 newly established projects, as listed in Table 2.2.

Table 2.2 Newly established and carried out research projects in 2022

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 ~ 2023-11-31

2	Industrial IoT Fibre Sensor Technology for Maglev Bogie Monitoring	Prof. Kang-Kuen Lee Prof. Hwa-Yaw Tam	Department of Electrical Engineering	2022-06-01 ~ 2023-12-30
3	Thermal analysis of laminated window glass panels of high-speed trains under extreme conditions by using an advanced matched interface and boundary method	Associate Prof. Siu-Kai Lai	Department of Civil and Environmental Engineering	2022-07-01 ~ 2024-01-01
4	Smart Technologies for Emerging Sensing, Absorption, Utilization, and Management of Energies in Electrified Transportation Infrastructures and Systems	Prof. Siu-Wing Or	Department of Electrical Engineering	2022-06-01 ~ 2023-12-31
5	Quantitative Assessment of the Acoustic Emissions from Rail Track Cracking	Assistant Prof. Qi Zhao	Department of Civil and Environmental Engineering	2022-05-01 ~ 2023-11-30
6	Predictive asset maintenance through intelligent algorithms	Associate Prof. You Dong	Department of Civil and Environmental Engineering	2022-09-01 ~ 2024-03-01
7	Energy Storage and Charging Techniques for Partial Catenary-free Railway System	Prof. Ka-Wai Cheng	Department of Electrical Engineering	2022-07-01 ~ 2023-12-31
8	High-performance vehicle suspension consisting of paralleled inerter and semiactive electromagnetic damper with dual functions of vibration control and	Prof. Song-Ye Zhu	Department of Civil and Environmental Engineering	2022-05-01 ~ 2023-11-31
9	Diffuse ultrasonic wave-based structural health monitoring for high-speed rail track	Prof. Zhong-Qing Su	Department of Mechanical Engineering	2022-07-01 ~ 2023-12-31
10	Edge-Cloud collaborative real-time railway monitoring platform	Prof. Jian-Nong Cao	Department of Computing	2022-11-01 ~ 2024-04-30
11	A Metaverse System for the Design and Inspection of Railway Structures	Prof. Dan Wang	Department of Computing	2022-11-01 ~ 2024-04-30

12	Digital-twin-enabled artificial intelligent damage detection and localization for train axle structures based on quasi-surface waves	Prof. Li Cheng	Department of Mechanical Engineering	2021-7-1 ~ 2022-4-30
13	Smart Materials, Devices, and Control Technologies for Emerging Sensing, Absorption, Conversion, and Storing of Energies in Railway Electrification Systems	Prof. Siu-Wing Or	Department of Electrical Engineering	2021-5-1 ~ 2022-4-30
14	Development of miniature high magnetic-field optical fibre sensor	Prof. Kang-Kuen Lee Prof. Hwa-Yaw Tam	Department of Electrical Engineering	2021-5-31 ~ 2022-4-30
15	Actively controlled secondary suspension of high-speed train with energy harvesting function	Prof. Song-Ye Zhu	Department of Civil and Environmental Engineering	2021-3-1 ~ 2022-3-31
16	A highly sensitive nanocomposite ultrasonic sensor fabricated from polydopamine-coated carbon nanotubes and graphene	Assistant Prof. Fang-Xin Zou	Department of Aeronautical and Aviation Engineering	2021-9-1~ 2022-8-31

2.2 Research Progress

2.2.1 Research Impact Fund (RIF) Project under Research Grants Council

Under the Research Grants Council's Research Impact Fund (RIF) Research Scheme, CNERC-Rail (HK Branch) is leading a Research Impact Fund project entitled "Enhancing Safety, Punctuality and Ride Comfort of Railway Transportation: From Local Metro to Global High-speed Rail Network". This project lasts 48 months, from June 1, 2019 to May 31, 2023. In total, a budget of HKD 8, 437, 600 was approved for this project. The fund came from four different sources. Research Grants Council provided HKD 5, 892, 320, PolyU provided a matching fund of HKD 1, 445, 280, City University of Hong Kong provided HKD 600, 000, and China SWJTU Railway Development Co., Ltd., provided a matching fund of HKD 500, 000.

This project aims to use new technologies including advanced sensing techniques, big data analysis, and artificial intelligence methods to enhance railway safety, punctuality, and ride comfort. It consists of six main tasks, including wheel/rail wear prediction, development of advanced train suspension system, smart sensing, wheel damage monitoring, rail short-pitch corrugation identification, and development of a hybrid long-range monitoring system for rail crack detection. The developed new technologies will be applied to different railway systems and networks to develop smart railway systems.

In the third year (from July 1, 2021 to June 30, 2022), the research team conducted extensive theoretical and experimental research and achieved fruitful outcomes on wheel-rail contact, machine learning algorithms for health monitoring of railway systems, energy collecting devices, train suspension systems, new technologies for railway electrification systems, vibration and noise control technologies in rail transit systems and fiber Bragg grating accelerometer-based rail crack detection. To put the research findings in practice, the research team has established collaborations with different railway enterprises and universities in China, to facilitate in the potential commercialization of new technologies in the railway industry, for improving the safety, punctuality, and riding comfort of the rail transit. Several in-situ tests and investigations were conducted in the third year, including online health monitoring of maglev systems in Hunan Fenghuang maglev line, track damage detection, rail status inspection, and control of vibration and noise in Shenzhen, Hangzhou and Hong Kong Metro systems, etc. In terms of research output, the research team submitted 38 research papers that directly arose

from this project in the second year, among which 31 papers have been accepted for publication. The third annual progress report was submitted to the Research Grants Council on August 31, 2022.

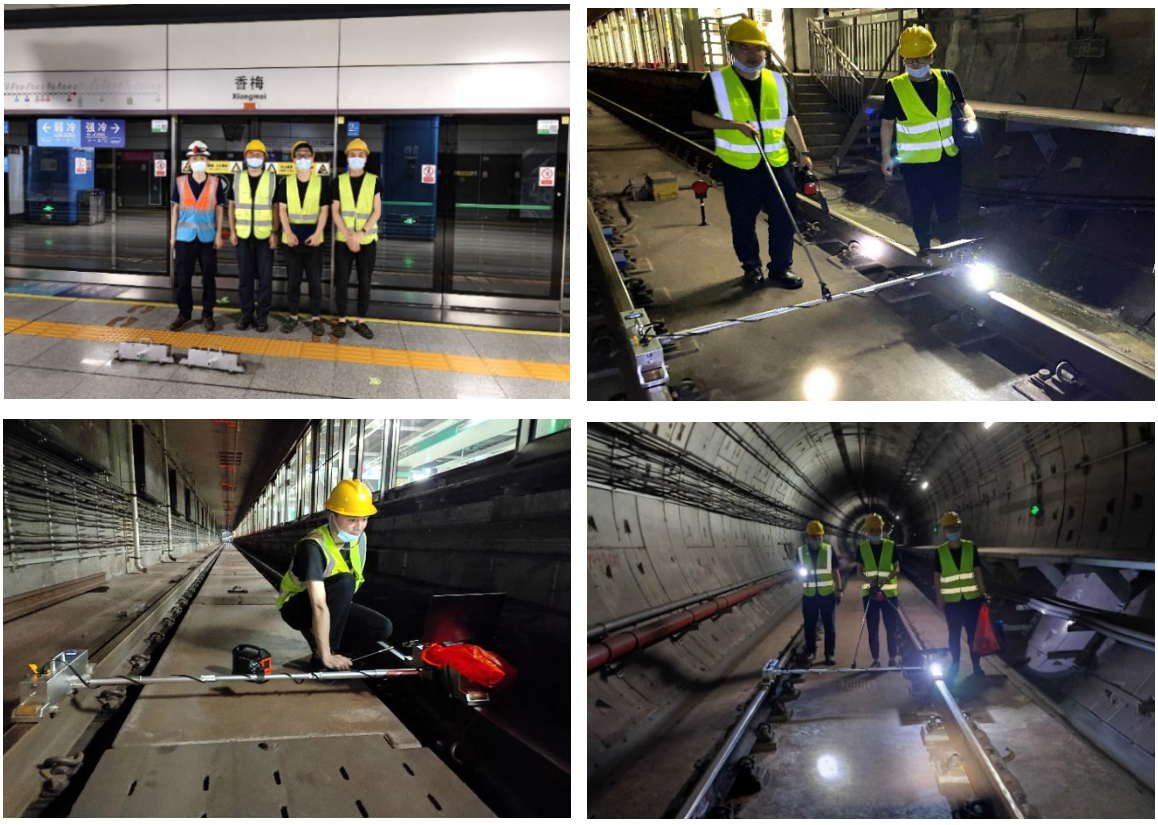


Fig. 2.1 Measurement on rail corrugation in an operating Shenzhen Metro line

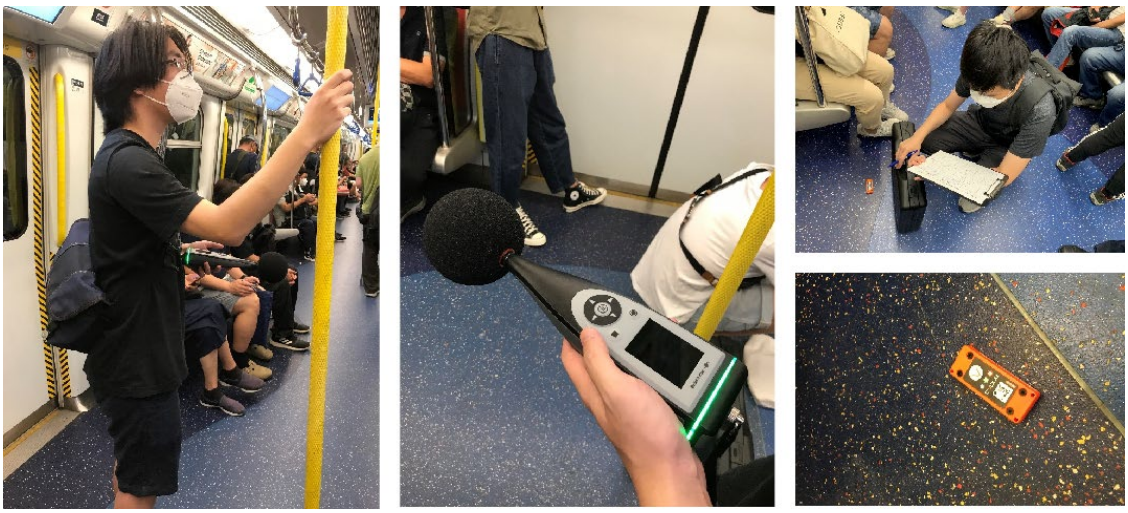


Fig. 2.2 Noise measurement on MTR trains

Fig. 2.3 Test on Fenghuang magelv monitoring system

2.2.2 Research on Modular Rail Particle Damper

Members of CNERC-Rail (HK Branch), including Prof. Yi-Qing Ni, Dr. Masoud Sajjadi, Dr. Chih-Shiuan Lin, Mr. Chao Zhang, Mr. Xin Ye, Mr. Yu-Ling Wang, developed a modular rail particle damper (MRPD) for rail corrugation control and broadband vibration and noise mitigation in rail transits. Three patents have been approved since the project began, including a new US patent: US 2022/03491. The MRPD technique has been included in "*The promotion collection of new techniques in Shenzhen construction engineering (2022)*". The research progress in this year is as follows.

1) Application in Shenzhen Metro Line 5

CNERC-Rail (HK Branch) and Shenzhen Metro Group Co., Ltd. have been working together to apply the MPRD technique in the viaduct section near Tanglang City East station of Shenzhen Metro Line 5. Members of CNERC-Rail (HK Branch), Dr. Masoud Sajjadi, Mr. Chao Zhang, Mr. Xin Ye, Mr. Yu-Ling Wang, Mr. Xiang-Xiong Li and Mr. Guang Zhou finished the investigation, and relevant vibration testing and noise monitoring work in early December 2021. Then, in early January 2022, some MRPDs were installed along the rail line.

Thereafter, members of CNERC-Rail (HK Branch) carried out abundant testing and analysis on the effect of the MRPD. In October 2022, a report entitled *Evaluation report on vibration and noise mitigation of MRPD in the tracks at Tanglang Station of Shenzhen Metro Line 5* was completed and submitted to Shenzhen Metro Group Co., Ltd. The vibration and noise mitigation performance of the MRPD were presented in detail in this report. The followings are the main conclusions: the MRPD achieves a higher vibration and noise mitigation performance in the frequency ranger higher than 800 Hz; the near-field and far-field noise can be decreased by 3-5 dB and 1-3 dB, respectively, with the adoption of the MRPD; In the range of high frequencies (1000-4000 Hz), half installation of the MRPD decreases the track horizontal acceleration by 10 g, and full installation of the MRPD decreases it by 12 g; the vibration of the track bed installed with the MRPD is reduced by up to 60% in some frequency range.

Fig. 2.4 Installation and testing of MRPD in the viaduct line near Tanglang City East station of Shenzhen Metro Line 5

2) Investigation before application in MTR Kowloon Bay depot

Squeal noise is produced in Kowloon Bay depot of MTR Kwun Tong Line when trains enter or leave the station. The noise is characterized by high sound pressure level, high frequency, and high annoyance degree. MTR Corp Ltd received complaints from surrounding residents about the noise. To find out the cause of the squeal noise and take appropriate mitigation measures, MTR Corp Ltd, and the vibration and noise reduction team of CNERC-

Rail (HK Branch) have jointly conducted investigation and tests on railway squeal noise in Kowloon Bay depot. In addition, exploration of the modular rail particle damper (MRPD) developed by CNERC-Rail (HK Branch) on suppressing the squeal noise was also conducted simultaneously. Currently, CNERC-Rail (HK Branch) has completed preliminary research on the squeal noise at Kowloon Bay depot and tests of the rail dynamic characteristics. In the future, installation, test, and evaluation of the MRPDs will be carried out at Kowloon Bay depot. Tasks already carried out are as follows:

(a) Analysis of squeal noise characteristics of Kowloon Bay depot

On June 16, 2022, Dr. Jason Lin, Mr. Chao Zhang, Mr. Yun-ke Luo, and Mr. Xin Ye of CNERC-Rail (HK Branch) conducted field investigation of the squeal noise at Kowloon Bay depot. The investigation included the environmental assessment of the railway track, collection, and preliminary analysis of noise signals. This work provided a foundation for follow-up testing and research work.

Fig. 2.5 Field investigation of squeal noise at Kowloon Bay depot

(b) Analysis of dynamic characteristics of rails on Kowloon Bay depot

On October 5, 2022, Dr. Vincent Ao, Dr. Duo Zhang, Dr. Zi-Yu Tao, Mr. Chao Zhang, Mr. Yun-Ke Luo, and Mr. Xin Ye of CNERC-Rail (HK Branch) conducted field tests, and

investigation on dynamic characteristics of rails in Kowloon Bay depot (Fig. 2.6). Impact hammer tests on several rail sections were carried out, followed by rail modal analysis. This work provides a basis for further investigation of the squeal noise and the design of dampers.

Fig. 2.6 Field test of the rail in Kowloon Bay depot

2.2.3 Research on MTR Rail Health Monitoring

A research team in CNERC-Rail (HK Branch), led by the Director of CNERC-Rail (HK Branch), Prof. Yi-Qing Ni, has participated in a collaborative research project with MTR Corp Ltd for monitoring the safety of one section of the Hong Kong rail lines.

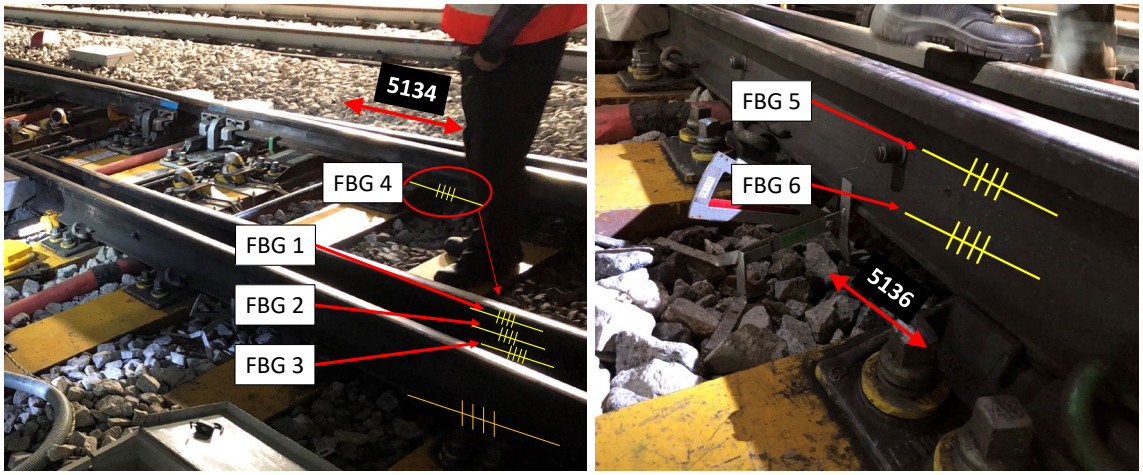
1) Health monitoring of the rail line near Hung Hom Station

From February 2022 to July 2022, Dr. Vincent Ao, Dr. Zheng-Wei Chen, Dr. Wen-Qiang Liu, Dr. Kenneth Lai, Dr. Qi Zhao, Mr. Da-Zhi Dang, Mr. Qi-Fan Zhou, Mr. Bo-Yang Su from CNERC-Rail (HK Branch) carried out several field inspections along several sections of MTR East Rail Line near Hung Hom Station. A monitoring plan was established after on-site evaluation and discussion with MTR Corp Ltd. Considering the complex site situation, fiber Bragg grating (FBG) sensors were chosen for installation on the rails. This optical sensing

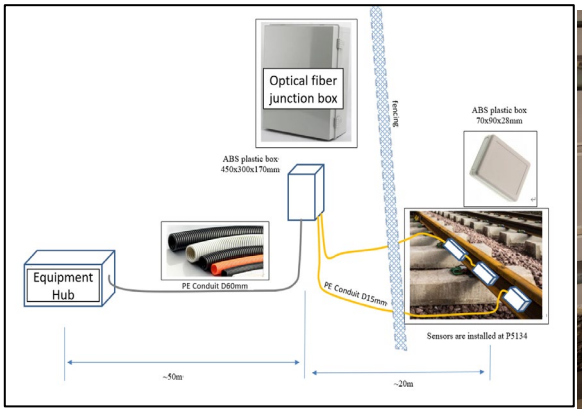
technology has the advantages of being electrically independent and immune to electromagnetic interference.

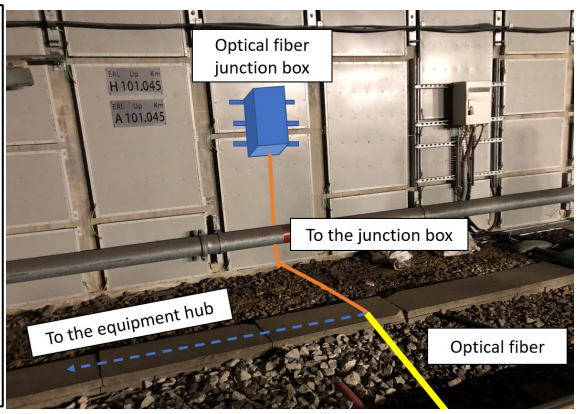
A total of 10 FBGs will be installed, 6 at railway 5134 and 5136, and 4 at the welding parts within this rail section. The sensor installation will be carried out in 2 phases. First, 6 FBG sensors will be installed near the turnout part of 5134 and 5136 railway to monitor the vertical and horizontal strains.

The locations of sensors are shown in Fig. 2.7(a). The optical fiber routing method is integrated by the junction box fixed by the slate paths on one side of the track and collecting to the equipment hub. At the same time, the optical fiber is organized and stored in the fiber optic junction box installed on the site fence. The detailed layout is shown in Fig. 2.7 (b) and (c).



(a) On-site installation of FBGs





(b) Optical fiber routing design (c) Optical fiber on-site routing

Fig. 2.7 FBG layout and optical fiber routing for rail health monitoring in Hung Hom Station

The location of the equipment hub is on the other side of the fence, separated from the railway (Fig. 2.8). The size of the hub is 1×1×2 m, and fed with power of 220V/13A, AC. Equipment hosted into the hub includes a SM130 optical interrogator, a PC, an air-conditioner,

a 5G router and a UPS (uninterruptable power supply). In the near future, CNERC-Rail (HK Branch) will continue to work with MTR Corp Ltd on installation and calibration of sensors.

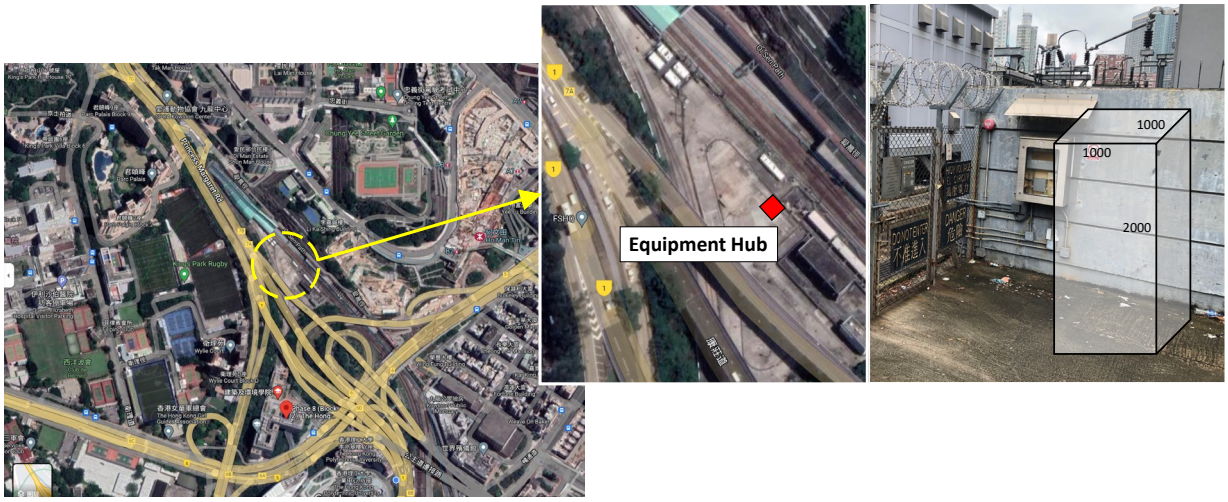


Fig. 2.8 Location of equipment hub for rail health monitoring in Hung Hom Station.

2) Health monitoring of rail line near Lo Wu Station

CNERC-Rail (HK Branch) members including Prof. Yi-Qing Ni, Dr. Kenneth Lai, Mr. Qi-Fan Zhou and Mr. Da-Zhi Dang visited the site and conducted surveys on March 23, 2022, and April 13, 2022. CNERC-Rail (HK Branch) and MTR Corp Ltd then formulated a basic plan for on-site health monitoring including schemes for sensor installation, as shown in Fig. 2.9.

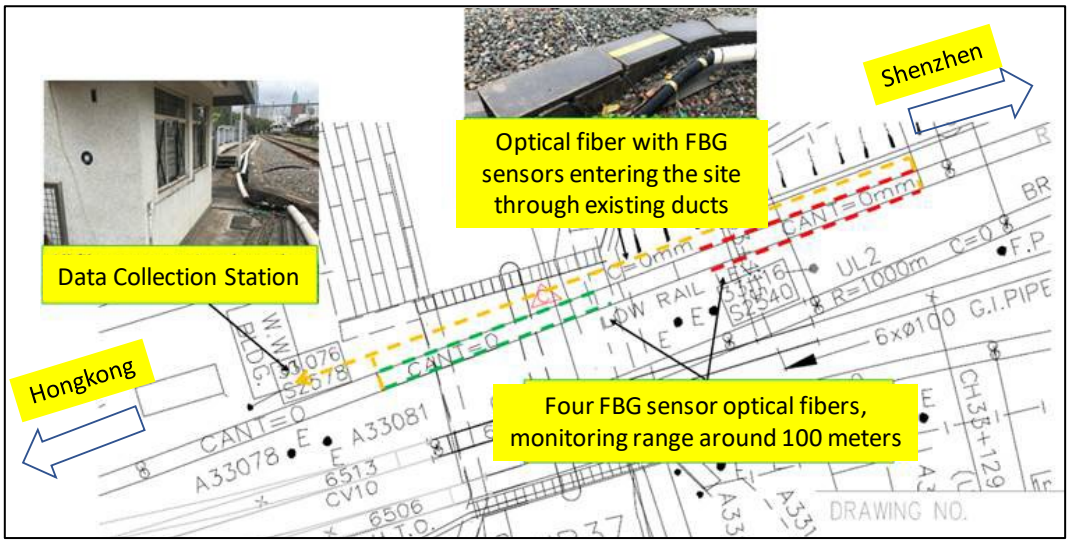


Fig. 2.9 Layout of monitoring optical fibers and FBG sensors in Lo Wu Station

Prior to the installation of the delicate sensors, two trial FBG sensors were installed on April 13, for initial checking of system stability, data transfer speed and sensor sensitivity. This trial operation provided the team with experimental bases for evaluating and refining the formal sensor installation plan, which was critical to enhancing the achievement of the research

project. As shown in Fig. 2.10, the data collection, sorting and storage equipment, linked to an UPS equipment, are placed in a small house nearby without causing any effect on the normal operation and maintenance of the track. The list of equipment include: SM130 Data collector, PC, 5G router and monitoring camera. As required by MTR Corp Ltd, the optical fiber is laid at the bottom of the rail along the routing as shown in Fig. 2.11(a), bypassing the fasteners and then crossing the track through the orange duct that passes through the bottom of the rail. To ensure a reliable and stable data acquisition environment, the long fiber would be securely fixed on the rail with terminals made of low-halogen, smokeless material and self-made FBG sensor boxes (see Fig. 2.11(b)).

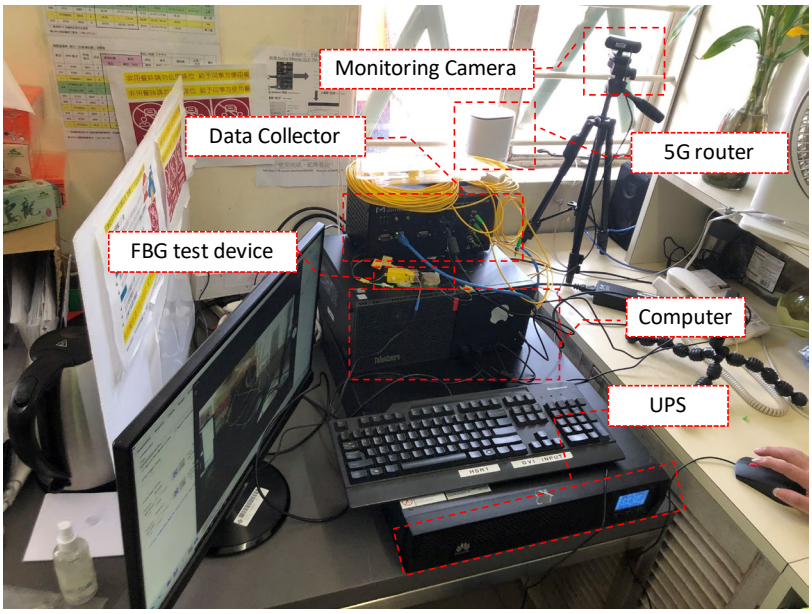


Fig. 2.10 On-site data processing equipment in Lo Wu Station

(a) Routing of optical fiber along rail. (b) Installation of FBG sensors on rail.

Fig. 2.11 Layout and installation of FBG sensors in Lo Wu Station

3) Welded rail performance tests in Fo Tan depot

On August 15, 2022, CNERC-Rail (HK Branch) members, including Dr. Kenneth Lai, Dr. Qi Zhao, Mr. Da-Zhi Dang, Mr. Qi-Fan Zhou and Mr. Bo-Yang Su, visited Fo Tan Depot to conduct joint experiments on testing the rail weld bending performance. Optical fiber sensors and piezoelectric acoustic emission sensors were installed on the rail tracks with aluminum welds. The bending tests followed EN 14730-1 (Section 7.3: Bend test). Optical Frequency Domain Reflector (OFDR) was used to detect longitudinal micro strains of the rail under loading. The team members then discussed rail safety issues with MTR Corp Ltd after the tests.

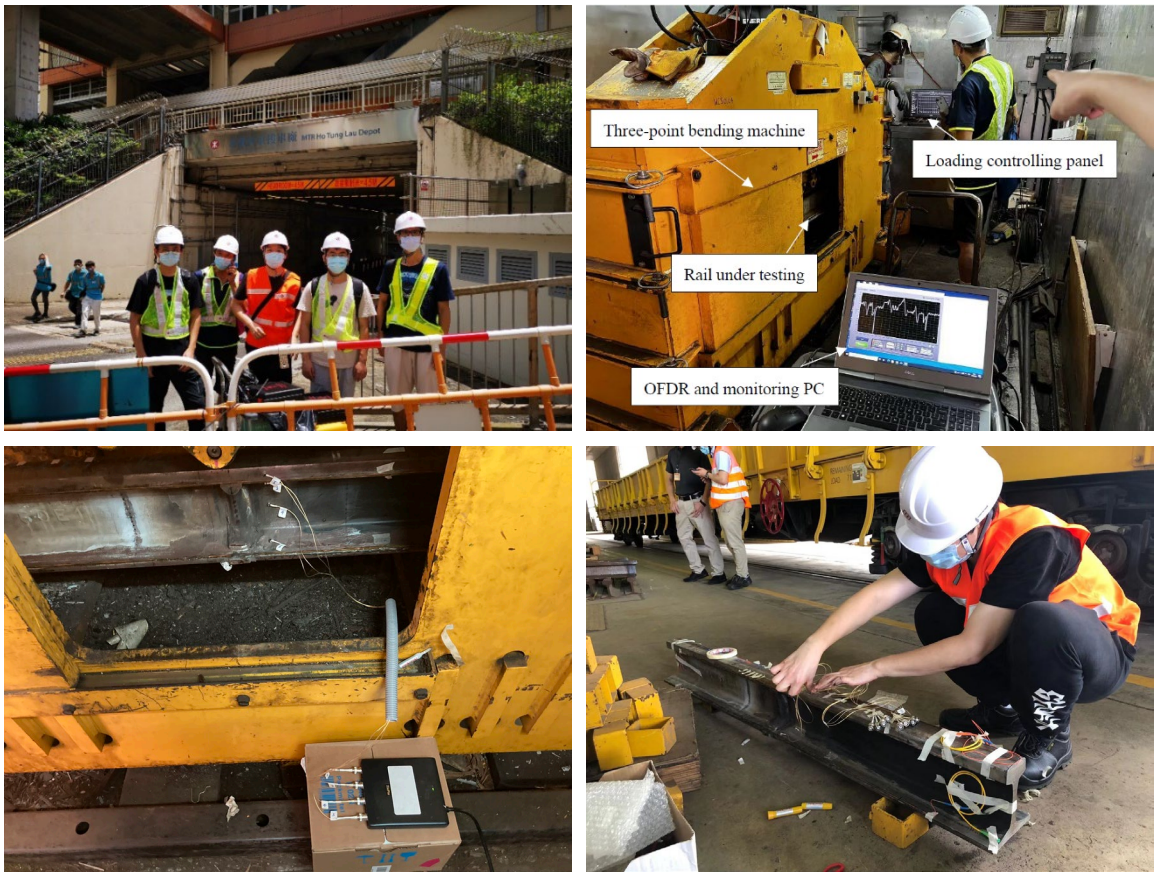


Fig. 2.12 Welded rail performance tests in Fo Tan depot

2.2.4 Research on Trackside Acoustic Technology for Diagnosis of Train Bearing Damage

At present, rolling bearings and other key components of many in-service trains have entered into the fault-prone stage of their life cycle. It is therefore essential to conduct more research on “train bearing condition monitoring and fault diagnosis” to develop technology to ensure the safe operation of urban rail transit and high-speed railway. Rolling bearings, which run at high speed, and are subjected to heavy load and strong shock, are parts of the most

important functional components of trains. However, due to the harsh working environment, rolling bearings of high-speed trains often have wear and tear, resulting in train breakdown and great economic losses. Micro-cracks caused by fatigue are often difficult to detect, and become a high risk to the safety and normal operation of trains. Comparing different detection methods, initial fatigue failure in bearings can be accurately identified by trackside acoustic signal processing, which can ensure the purpose of condition monitoring and detect diagnosis of rolling bearings, with good application prospect. The progress of scientific research on this technology in this year is summarized below.

1) Test of rolling test bench for train wheelset bearing in laboratory

From September to October 2022, Mr. You-Liang Zheng, a member of CNERC-Rail (HK Branch), collected data from healthy and artificially damaged (inner ring, outer ring, roller, mixed fault) train wheelset bearings under different rolling speeds (10km/h-200km/h) in the laboratory of Shenzhen Research Institute of PolyU (Fig. 2.13). The data include multi-channel observed acoustic signals and acceleration signals. The purpose of the test was to separate the bearing damage signals from the mixed sources to allow fault diagnosis of train bearings.

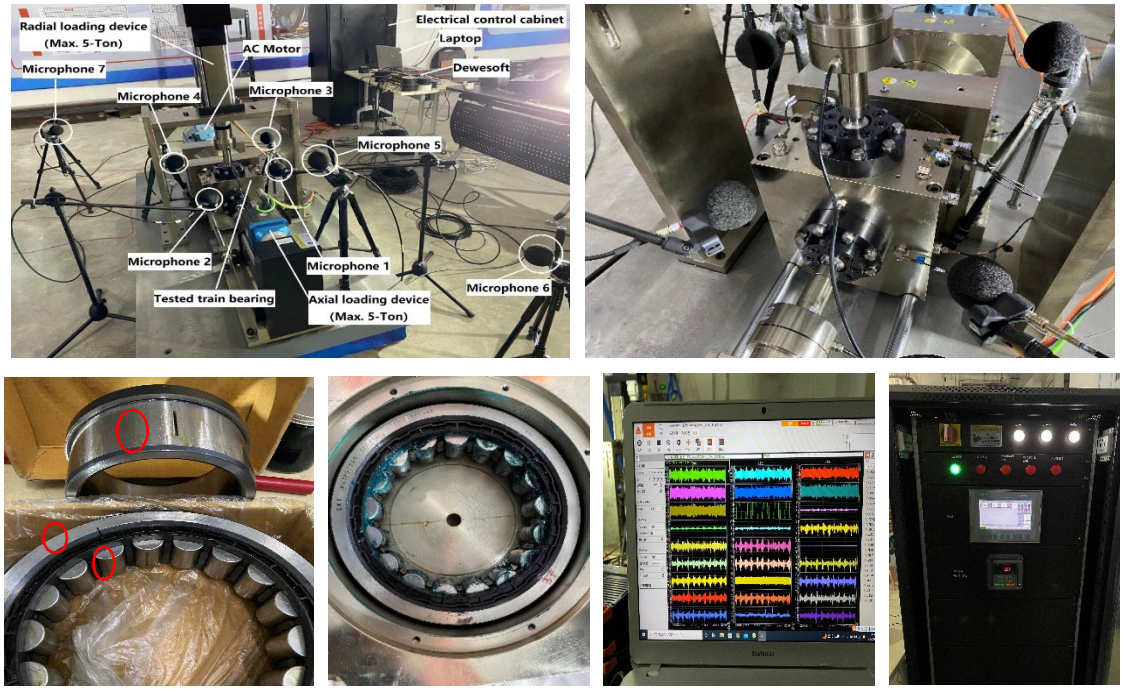


Fig. 2.13 Construction of rolling test bench and acquisition of train wheelset bearing data in laboratory

2) Roadside test to simulate trackside test of bearing damage in train wheelset

In October 2022, Mr. You-Liang Zheng and Mr. Guang Zhou, members of CNERC-Rail (HK Branch), carried out a roadside test at Yuexing road next to the Shenzhen Research Institute of PolyU (Fig. 2.14). For safety reasons, trains with known bearing faults cannot run,

and a loudspeaker needed to be installed on the axle box in the field test. The fault audio signal collected in the laboratory during the rolling of the damaged bearing was played through a bluetooth connection to simulate the fault signal from the damaged wheelset bearing. When the car moved at a constant speed, the signal collected by the roadside microphone set exhibited Doppler distortion due to the change in the relative position of the fault source and the microphone. From this experiment, the effect of Doppler distortion correction could be verified.

Fig. 2.14 Roadside test to simulate trackside test of bearing damage in train wheelset and loudspeaker fixing

3) On-site investigation of trackside acoustic testing in Zhuzilin depot of Shenzhen Metro

On November 23, 2022, Mr. You-Liang Zheng and Mr. Guang Zhou, members of CNERC-Rail (HK Branch), and Mr. Qiao Kun of Jiaotong University Rail Technology (Shenzhen) Co., Ltd. visited the control center of Zhuzilin Depot of Shenzhen Metro and the trackside acoustic test site of the depot to investigate the model and axle box structure of metro vehicles, and to confirm the scheme for installation of loudspeakers, as well as on-site route for designing the trackside acoustic monitoring scheme.

Fig. 2.15 Investigation of the control center of the depot

On December 19, 2022, Mr. You-Liang Zheng and Mr. Xiang-Xiong Li, members of CNERC-Rail (HK Branch), went to Zhuzilin Depot of Shenzhen Metro to conduct a field test of trackside acoustics for train wheelset bearing damage. Main work: fixed installation of Bluetooth loudspeaker on the front cover of bogie axle box of the first carriage (trailer) and the third carriage (power car) of metro train to play the acoustic audio signal when the wheel set bearing is damaged; the installation of the trackside acoustic test system mainly consists of a linear array of six microphones to monitor the damage of the wheelset bearing of the running vehicle. The infrared laser sensor is used to locate the position of the bearing; online monitoring of trackside acoustic bearings, the accuracy of fault diagnosis of trackside acoustic bearings is verified by monitoring the damage of wheelset bearings under different speed conditions (20km/h and 60km/h) and under known conditions of different bearing damage parts (outer ring fault, inner ring fault, roller fault).

Fig. 2.16 Installation of trackside acoustic testing system for Shenzhen Metro

2.2.5 Investigation of Anomalous Corrugation and Regional Fastening Clip Fractures of MTR Tuen Ma Line

With the rapid development of urban rail transportation, the pressure of people's daily travel has been greatly relieved. At the same time, the anomalous vibration of the train caused by the rail corrugation problem also gradually appear. Tuen Ma Line Phase I opened in 2020. After operating for a short period of time, anomalous rail corrugation appeared in the line between Diamond Hill Station and Kai Tak Station. Rail corrugation causes anomalous vibration and noise of the vehicle, which not only affect riding comfort of passengers; but also aggravate wear and tear of the rail, and deterioration of components of the track system, resulting in higher cost of operation and maintenance, and risk to safety. In the section where corrugation occurs frequently, part of the fastening clips has broken.

Noting the above problems, MTR Corp Ltd and CNERC-Rail (HK Branch) have cooperated to study the anomalous corrugation of the rails and solutions for anomalous fracture of the fastening clip. At present, CNERC-Rail (HK Branch) has completed the preliminary research and preparation work. On May 26, 2022, Associate Professor Siu-Kai Lai, Dr. Jason LIN, Mr. Chao Zhang, Mr. Yun-Ke Luo, Mr. Da-Zhi Dang and Mr. Qi-Fan Zhou from CNERC-Rail (HK Branch), conducted a site survey on rail corrugation and fastening clip fracture in the section between Diamond Hill and Kai Tak of MTR Tun Ma Line. During the

investigation, the team collected data on the characteristics of the rail corrugation in this section and recorded the number of occurrences of fastening clip fracture in the same section for analysis and comparison. Other field tests will be conducted in early 2023.

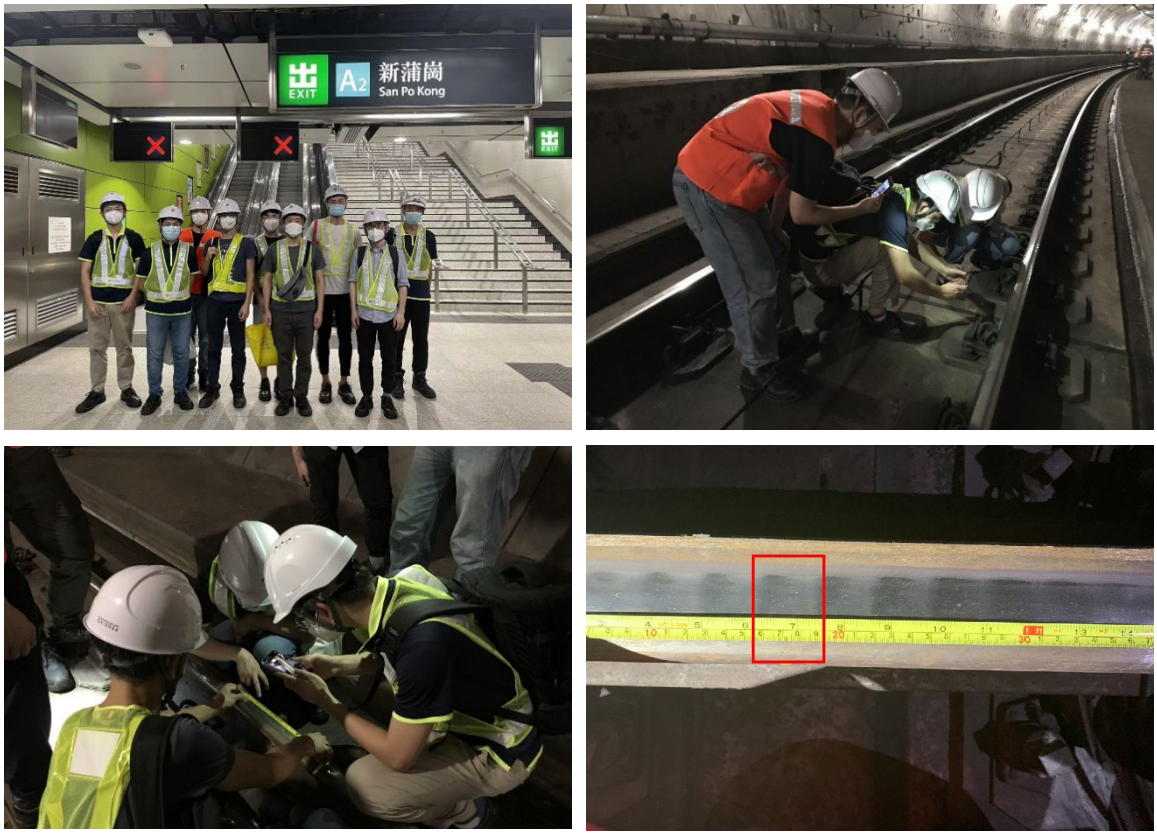


Fig. 2.17 Site investigation of the line section between Diamond Hill Station and Kai Tak Station

2.2.6 Construction Monitoring of Zengjiang Bridge of Guangzhou-Shantou High-Speed Railway

Guangzhou-Shantou high-speed railway (from Guangzhou to Shanwei) is in a total length of 206.2 km with 7 new stations, and the designed railway speed is 350 km/h. Zengjiang Bridge is a key part of the Guangzhou-Shantou high-speed railway line. It is a concrete cable-stayed bridge with two towers and two cable planes. Its total length is 526 m and with a main span of 260 m. CNERC-Rail (HK Branch) is engaged in “Key technology research on long-span segment of precast concrete cable stayed bridge in Guangshan high-speed railway”. During the period from March 2022 to June 2022, Mr. Xiang-Xiong Li and Dr. E Deng, from CNERC-Rail (HK Branch), stationed on site to perform full-area scaning of some concrete girders during prefabrication and during lifting, respectively. Several cross-sectional scaning were performed before and after the bridge closure from August 2, 2022, to August 19, 2022, to obtain the corresponding point cloud model data. The member of CNERC-Rail (HK Branch)

first proposes a 3D coordinate recognition method of geometric control points based on target paper, and the scanning results of this method are compared with the corresponding results obtained by total station measurement to verify the accuracy of the method. Then, a 3D laser scanner was used to obtain the point cloud data of each stationary concrete segmental girder in the beam yard, for conducting virtual preassembly of the concrete segmental girders. Afterwards, the alignment obtained from the virtual preassembly and transformed by 3D coordinates was compared with the designed precast alignment to analyze the corresponding deviation law and mechanism. This method is expected to replace the traditional physical preassembly process in the construction of concrete precast segmental girder cable-stayed bridges, reduce construction costs and improve construction efficiency.

Fig. 2.18 Scanning work during the construction of Zengjiang Bridge

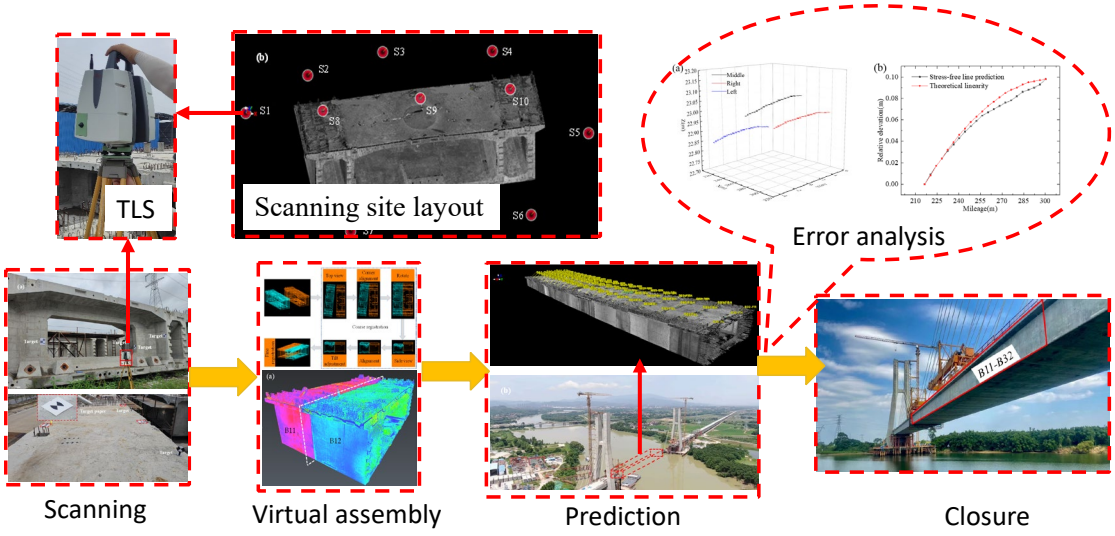


Fig. 2.19 Construction Monitoring of Zengjiang Bridge

2.2.7 Health Monitoring of Fenghuang Magelv System

From December 2021 to April 2022, the maglev team members Dr. Su-Mei Wang, Mr. Yang Lu, Mr. Gao-Feng Jiang, Mr. Shuo Hao, Ms. Qi Zhu and Mr. Sheng-Yuan Liu conducted tests for maglev train-track-bridge coupling vibration and deformation monitoring on the Fenghuang Maglev Sightseeing Express in Fenghuang County, Hunan Province. The test site is located in Fenghuang County, Hunan Province. The maglev line starts from Fenghuang High-speed Railway Station, passes through the Chengbei Tourist Service Center, and finally ends at Folk Custom Garden of 209 ring line, with a total length of 9.1 kilometers, including steel turnout, concrete straight segments, concrete curves with small radius, concrete ramp segments, and tunnel segments. The test vehicle was a medium-speed maglev train from CRRC Zhuzhou Locomotive Co., Ltd.

Fig. 2.20 Installation of sensors and monitoring of Fenghuang magelv system

The main purpose of the test is to analyze the dynamic response of the maglev train-track-bridge system under different operating conditions, and to evaluate the stability of the vehicle during operation, so as to analyze the structural performance of each section of the line (straight section, curve section, tunnel section, turnout section), and the dynamic state of the vehicle passing through different line sections at different speeds is systematically analyzed and evaluated. The data came from online monitoring systems installed on the running vehicle,

tracks and bridges. Specific research objectives are as follows: 1. the analysis results provide support for further optimization of the electromagnetic control system, 2. combined with the vibration data of suspension bogie and carriage, the weakening effect of second-series suspension system on the vibration of the vehicle substructure (below the air spring) is tested, and relevant optimization suggestions are proposed. 3. according to the monitoring data of the vehicle passing through different sections of the track, on the one hand, the adaptability of the current train state to different lines is tested, on the other hand, the working performance of the track line is tested, 4. based on the monitoring data, the stationarity (comfort index) of the train running through the whole line is evaluated quantitatively, 5. track irregularity detection is carried out in the section of the track where track accuracy is hard to be controlled due to the difficulty of track construction. Some of sensor layouts are shown in Fig. 2.21 and Fig. 2.22.

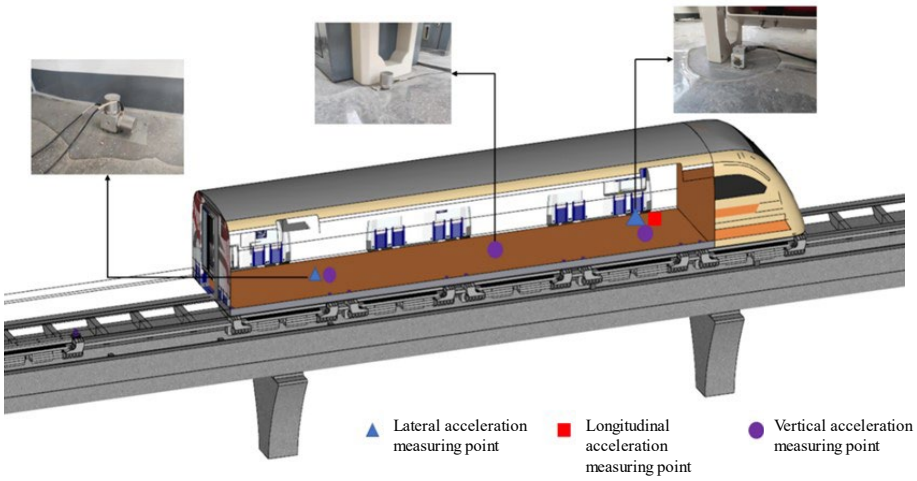


Fig. 2.21 Schematic diagram of carriage sensor layout

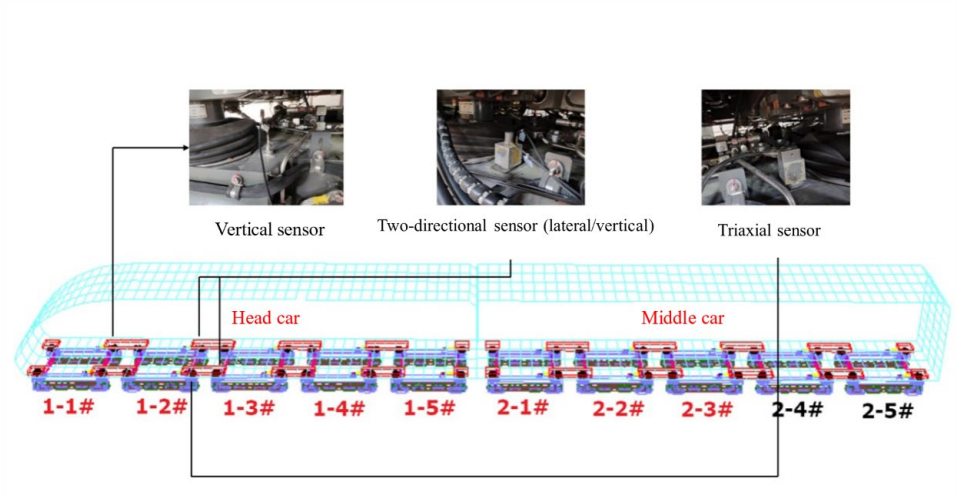


Fig. 2.22 Schematic diagram of bogie measuring points

In order to meet the testing requirements of monitoring different objects, this online monitoring system is equipped with various types of sensors such as piezoelectric vibration sensors, laser displacement sensors, and optical fiber sensors. The maglev team assisted the operator of the Fenghuang Maglev Sightseeing Express Line and other equipment suppliers to complete the operation and debugging of the entire line, including the debugging of the maglev suspension control system and the leveling of track irregularities. In addition, based on the data obtained from the test, maglev team completed the analysis of the maglev train-track-bridge coupling vibration mechanism and vehicle comfort evaluation. We also began to build the maglev train-track-bridge digital twin monitoring platform. The members of CNERC-Rail (HK Branch) have conducted detailed analysis of the data obtained and written the "Report on monitoring data analysis of Fenghuang maglev train-track-bridge coupling vibration and deformation", which has been submitted to the relevant cooperation units.

2.2.8 Research on Intelligent Online Monitoring of Self-aware Composite ATC Antenna Beams

Carbon fiber composite materials are widely used in the development of lightweight rail transportation equipment because of their advantages of lightweight and high strength, designable performance, and easy overall manufacturing. In this context, Hunan Railway Vehicle Bogie Engineering Technology Research Center and Railway Engineering Hong Kong Branch signed a cooperation agreement to cooperate in the research and development of self-aware carbon fiber composite antenna beam service period online monitoring technology based on fiber grating sensing technology.

In order to develop intelligent online monitoring technology for self-aware carbon fiber composite Automatic Train Control (ATC) antenna beams. From November 27 to December 11, 2022, Mr. Xiang-Xiong Li and Mr. Guang Zhou, members of CNERC-Rail (HK Branch), and Associate Professor Hua-Ping Wang's team from Lanzhou University went to China Railway Zhuzhou Electric Co. Ltd. to perform a series of tests on the dynamic performance of the carbon fiber composite ATC antenna beam, such as modal, sweep, vibration and shock, and single frequency band dwell, as shown in Fig. 2.21. The main work includes the design of fiber grating sensor deployment scheme, installation and networking methods, data acquisition and processing, etc. The purpose of the test is to explore the effectiveness and reliability of advanced fiber grating sensing technology to measure the static and dynamic characteristics of carbon fiber composite ATC antenna beams, to provide an effective test technology for the

performance evaluation of carbon fiber composite antenna beams, and to provide a preliminary research basis for the development of self-aware carbon fiber composite ATC antenna beams, in order to promote the intelligent and lightweight integration of ATC antenna beams. The preliminary analysis of the test shows that the fiber grating sensor deployed on the surface of the carbon fiber composite ATC antenna beam can measure its dynamic response more accurately and stably, and the installation of the sensing and monitoring system has no additional influence on the static and dynamic performance of the carbon fiber composite ATC antenna beam. In the future, the Hong Kong Branch of Railway Engineering Center will monitor the dynamic stress state and fatigue life of the developed self-aware composite ATC antenna beam in real operating environment.

Fig. 2.23 Self-aware composite ATC antenna beam field test

2.2.9 Dynamic Mechanical Thermal Analysis Laboratory

Dynamic mechanical thermal analysis determines the mechanical properties of a material as a function of time, temperature, and frequency. In addition to basic material properties such as stiffness, Young's modulus, etc., dynamic mechanical analyzers (DMAs) are also commonly used to measure more complex viscoelastic properties including glass transition temperature, process-induced changes, cold crystallization, curing optimization, effects of fillers in composites, and more. DMAs ensure the accuracy of material stiffness (modulus) measurements, as well as other important mechanical properties such as damping, creep and stress relaxation. The laboratory has introduced a dynamic mechanical analyzer DMA850 from TA Instruments (as shown below). The instrument is composed of a dynamic mechanical testing platform, a gas cooling system, and tensile, three-point bending, single or double cantilever bending, compression and other deformation fixtures. The instrument can host a variety of tests in a temperature range of -150 to 600 °C and a load range of 0.1 mN to 18 N.

Fig. 2.24 Dynamic mechanical analyzer DMA850

2.3 Research Outcomes

In 2022, CNERC-Rail (HK Branch) published 43 SCI papers, 3 theme reports, 17 international conferences, won 7 awards, granted 5 patents, and applied for 4 patents.

2.3.1 International Journal Publications

1. Sun, X.T., Guo, C.R., Yuan, L., Kong, Q.Z., and Ni, Y.Q. (2022), "Diffuse ultrasonic wave-based damage detection of railway tracks using PZT/FBG hybrid sensing system", *Sensors*, Vol. 22, No. 7, Paper No. 2504. https://doi.org/10.3390/s22072504 (SCI)
2. Yuan, L., Ni, Y.Q., Deng, X.Y., and Hao, S. (2022), "A-PINN: Auxiliary physics informed neural networks for forward and inverse problems of nonlinear integro-differential equations", *Journal of Computational Physics*, Vol. 462, Paper No. 111260. https://doi.org/10.1016/j.jcp.2022.111260 (SCI)
3. Ye, X., Ni, Y.Q., Sajjadi, M., Wang, Y.W., and Lin, C.S. (2022), "Physics-guided, data-refined modeling of granular material-filled particle dampers by deep transfer learning", *Mechanical Systems and Signal Processing*, Vol. 180, Paper No. 109437. https://doi.org/10.1016/j.ymssp.2022.109437 (SCI)
4. Zhang, Q.H., and Ni, Y.Q. (2022), "A Bayesian hypothesis testing-based statistical decision philosophy for structural damage detection", *Structural Health Monitoring*, Paper No. 14759217221133292. https://doi.org/10.1177/14759217221133292 (SCI)
5. Ying, Z.G., Ruan, Z.G., and Ni, Y.Q. (2022), "Response adjustability analysis of partial and ordinary differential coupling system for visco-elastomer sandwich plate coupled with distributed masses under random excitation via spatial periodicity strategy", *Symmetry*, Vol. 14, No. 9, Paper No. 1794. https://doi.org/10.3390/sym14091794 (SCI)
6. Chen, S.Y., Wang, Y.W., and Ni, Y.Q. (2022), "Gross outlier removal and fault data recovery for SHM data of dynamic responses by an annihilating filter-based Hankel-structured robust PCA method", *Structural Control and Health Monitoring*, Vol. 29, No. 12, Paper No. e3144. https://doi.org/10.1002/stc.3144 (SCI)
7. Wang, Y.W., Ni, Y.Q., and Wang, S.M. (2022), "Structural health monitoring of railway bridges using innovative sensing technologies and machine learning algorithms: a concise review", *Intelligent Transportation Infrastructure*, Vol. 1. https://doi.org/10.1093/iti/liac009 (SCI)
8. Chen, S.X., Zhou, L., and Ni, Y.Q. (2022), "Wheel condition assessment of high-speed

trains under various operational conditions using semi-supervised adversarial domain adaptation", *Mechanical Systems and Signal Processing*, Vol. 170, Paper No. 108853. https://doi.org/10.1016/j.ymssp.2022.108853 (SCI)

9. Chen, Z.W., and Ni, Y.Q. (2022), "Sudden flow induced by mountain ridges beside windbreaks in a railway and its mitigation measures", *Transportation Safety and Environment*, Vol. 4, No. 1, Paper No. tdac004. https://doi.org/10.1093/tse/tdac004 (SCI)
10. Xu, C., Ni, Y.Q., and Wang, Y.W. (2022), "A novel Bayesian blind source separation approach for extracting non-stationary and discontinuous components from structural health monitoring data", *Engineering Structures*, Vol. 269, Paper No. 114837. https://doi.org/10.1016/j.engstruct.2022.114837 (SCI)
11. Wang, Y.W., and Ni, Y.Q. (2022), "Full-scale monitoring of wind effects on a supertall structure during six tropical cyclones", *Journal of Building Engineering*, Vol. 45, Paper No. 103537. https://doi.org/10.1016/j.jobe.2021.103507 (SCI)
12. Luo, Y.K., Chen, S.X., Zhou, L., and Ni, Y.Q. (2022), "Evaluating railway noise sources using distributed microphone array and graph neural networks", *Transportation Research Part D: Transport and Environment*, Vol. 107, Paper No. 103315. https://doi.org/10.1016/j.trd.2022.103315 (SCI)
13. Wang, Q.A., Zhang, C., Ma, Z.G., Jiao, G.Y., Jiang, X.W., Ni, Y.Q., Wang, Y.C., Du, Y.T., Qu, G.B., and Huang, J.D. (2022), "Towards long-transmission-distance and semi-active wireless strain sensing enabled by dual-interrogation-mode RFID technology", *Structural Control and Health Monitoring*, Vol. 29, No. 11, Paper No. e3069. https://doi.org/10.1002/stc.3069 (SCI)
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15. Deng, X.Y, Ni, Y.Q., and Liu, X. (2022), "Numerical analysis of transient wheel-rail rolling/slipping contact behaviors", *Journal of Tribology*, Vol. 144, No. 10, Paper No. 101503. https://doi.org/10.1115/1.4054592 (SCI)
16. Luo, Y.K., Zhou, L., and Ni, Y.Q. (2022), "Towards the understanding of wheel-rail flange squeal: In-situ experiment and genuine 3D profile-enhanced transient modelling", *Mechanical Systems and Signal Processing*, Vol. 180, Paper No. 109455. https://doi.org/10.1016/j.ymssp.2022.109455 (SCI)

17. Sajjadi Alehashem, S.M., Wang, J.F., and Ni, Y.Q. (2022), "Vibration control of structures against near-field earthquakes by using a novel hydro-pneumatic semi-active resettable device", *Structural Control and Health Monitoring*, Vol. 29, No. 11, Paper No. e3054. https://doi.org/10.1002/stc.3054 (SCI)
18. Wang, S.M., Ni, Y.Q., Sun, Y.G., Lu, Y., and Duan, Y.F. (2022), "Modelling dynamic interaction of maglev train-controller-rail-bridge system by vector mechanics", *Journal of Sound and Vibration*, Vol. 533, Paper No. 117023. https://doi.org/10.1016/j.jsv.2022.117023 (SCI)
19. Chen, S.X., Ni, Y.Q., and Zhou, L. (2022), "A deep learning framework for adaptive compressive sensing of high-speed train vibration responses", *Structural Control and Health Monitoring*, Vol. 29, No. 8, Paper No. e2979. https://doi.org/10.1002/stc.2979 (SCI)
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2.3.2 Theme Reports

1. Ni, Y.Q. (2022), Keynote speech "Sensing technology meets scientific machine learning: Applications from metro to maglev" at *The 10th European Workshop on Structural Health Monitoring*, July 4-7, 2022, Palermo, Italy. (Fig. 2.25)
2. Ni, Y.Q. (2022), Keynote speech "Physics-informed machine learning and transfer learning for structural health monitoring and vibration control" at *The 8th World Conference on Structural Control and Monitoring*, June 5-8, 2022, Orlando, Florida, USA. (Fig. 2.26)
3. Ni, Y.Q. (2022), Keynote speech "Transfer learning, graph neural networks, and physics-informed neural networks and their applications in structural health monitoring and vibration control" at *The 2nd International Forum of NFEES on Artificial Intelligence & Disaster Prevention and Mitigation (IFNFEES02)*, July 1-2, 2022, Tianjin, China. (Fig. 2.27)

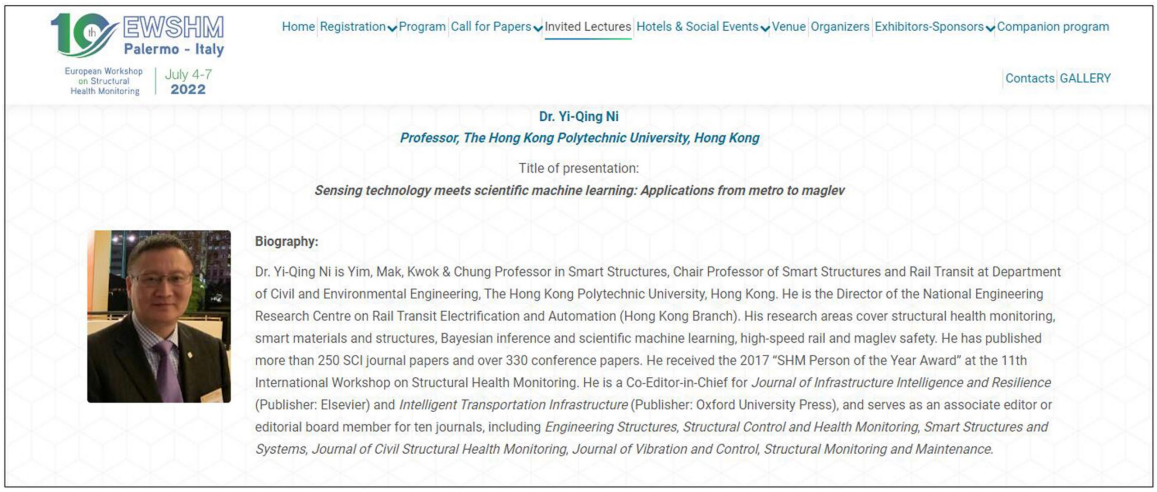

Fig. 2.25 Keynote speech "Sensing technology meets scientific machine learning: Applications from metro to maglev" by Prof. Yi-Qing Ni at *The 10th European Workshop on Structural Health Monitoring*

Fig. 2.26 Keynote speech "Physics-informed machine learning and transfer learning for structural health monitoring and vibration control" by Prof. Yi-Qing Ni at *The 8th World Conference on Structural Control and Monitoring*

Fig. 2.27 Keynote speech "Transfer learning, graph neural networks, and physics-informed neural networks and their applications in structural health monitoring and vibration control" by Prof. Yi-Qing Ni at *The 2nd International Forum of NFEES on Artificial Intelligence & Disaster Prevention and Mitigation (IFNFEES02)*

2.3.3 International Conferences

1. Lin, Z., and Ni, Y.Q. (2022), "Wireless optical fibre-based humidity sensor system for seawater sea-sand concrete", *Fifth International Workshop on Seawater Sea-sand Concrete (SCC) Structures Reinforced with FRP Composites*, January 15-16, 2022, Hong Kong Polytechnic University, Hong Kong, China.
2. Liu, W.Q., and Ni, Y.Q. (2022), "An efficient foreign object intrusion detection method for ballast tracks based on deep segmentation convolutional neural network", *Proceedings of the 8th World Conference on Structural Control and Monitoring*, June 5-8, 2022, Orlando, Florida, USA.
3. Jiang, G.F., Wang, S.M., and Ni, Y.Q. (2022), "Unsupervised discrepancy-based domain adaptation for multiple damage detection of maglev rail joints", *Proceedings of the 8th World Conference on Structural Control and Monitoring*, June 5-8, 2022, Orlando, Florida, USA.
4. Zhou, Q.F., Wang, Y.W., and Ni, Y.Q. (2022), "Bayesian approaches for estimation of suspension bridge deflection variation under thermal effect", *Proceedings of the 8th World Conference on Structural Control and Monitoring*, June 5-8, 2022, Orlando, Florida, USA.
5. Jiang, G.F., Wang, S.M., and Ni, Y.Q. (2022), "Maglev malfunction analysis based on time-

frequency spectrogram from rail acceleration data", *The 10th National Maglev Technology and Vibration Control Academic Conference*, July 29 – August 1, 2022, Shenyang, China.

6. Dong, Y., Guo, Y.L., Chen, Z.W., and Ni, Y.Q. (2022), "A meta-model of the wind field for a generic building cluster layout", *The Engineering Mechanics Institute Conference 2022*, May 31 - June 3, 2022, Johns Hopkins University, Baltimore, Maryland, USA.
7. Rui, E.Z., Chen, Z.W., Ni, Y.Q., and Yuan, L. (2022), "Full domain flow information recognition around buildings with sparse near-wall data through a physics-informed data-driven approach", *Proceedings of the 8th World Conference on Structural Control and Monitoring*, June 5-8, 2022, Orlando, Florida, USA.
8. Sajjadi Alehashem, S.M., Ye, X., Zhang, C., and Ni, Y.Q. (2022), "Experimental evaluation on broadband noise and vibration reduction performance of a novel rail particle damper through an in-situ test", *Proceedings of the 8th World Conference on Structural Control and Monitoring*, June 5-8, 2022, Orlando, Florida, USA.
9. Chen, Z.W., and Ni, Y.Q. (2022), "Aerodynamic performance of a train passing through a hillock region beside a windbreak and flow mitigation measures", *The Fifth International Conference on Railway Technology: Research, Development and Maintenance*, August 22-25, 2022, Montpellier, France.
10. Luo, Y.K., Zhou, L., and Ni, Y.Q. (2022), "To understand the wheel-rail flange squeal through the contact perspective", *12th international conference on contact mechanics and wear of rail/wheel systems (CM2022)*, September 4-7, 2022, Melbourne, Australia.
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13. Lu, Y. (2022), "3D dynamic response of short stator maglev train-track-bridge system: Verification of numerical modelling using monitoring data", *Proceedings of the 8th World Conference on Structural Control and Monitoring*, June 5-8, 2022, Orlando, Florida, USA.
14. Zhu, Q., Wang, S.M., and Ni, Y.Q. (2022), "Adaptive nonlinear suspension control of maglev trains by deep reinforcement learning", *Proceedings of the 8th World Conference on Structural Control and Monitoring*, June 5-8, 2022, Orlando, Florida, USA.
15. Wang, S.M., Zhu, Q., Ni, Y.Q., and Xu, J.Q. (2022), "Experimental study on dynamic

performance of low- and medium-speed maglev train running on the turnout", *The 25th International Conference on Magnetically Levitated System and Linear Drives (Maglev 2022)*, October 17-19, 2022, Changsha, China.

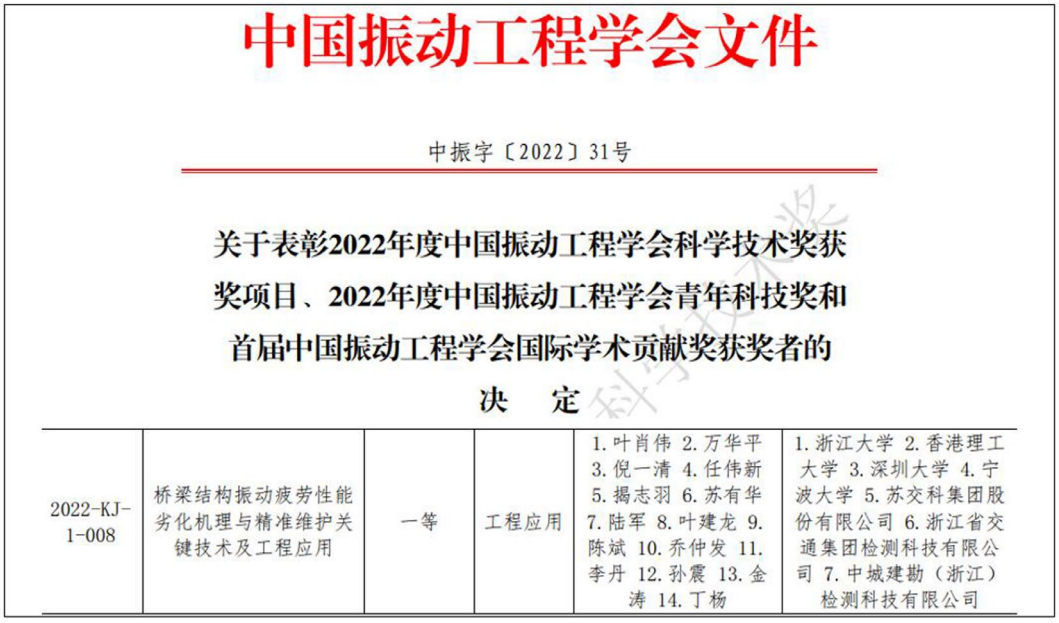
16. Wang, H., and Cheng, K.W.E. (2022), "Conical coil design for domino wireless power transfer", *IEEE The 2022 20th Biennial IEEE Conference on Electromagnetic Field Computation (CEFC)*, October 24-26, 2022, USA.
17. Wang, H., and Cheng, K.W.E. (2022), "A special magnetic coupling structure design for wireless power transfer systems", *IEEE The 2022 20th Biennial IEEE Conference on Electromagnetic Field Computation (CEFC)*, October 24-26, 2022, USA.

2.3.4 Awards and Patents

1. Recipient of the First Prize Award of Science and Technology, China Vibration Engineering Society, 2022 (Prof. Yi-Qing Ni. (2022), "Mechanism of vibration fatigue degradation of bridge structures and key technologies for accurate maintenance and engineering application"). (Fig. 2.28)
2. Prof. Song-Ye Zhu, Fellow of Hong Kong Institution of Engineers, 2022. (Fig. 2.29)
3. Prof. Song-Ye Zhu, The HKIE Structural Division Excellence Award 2022 (R&D Award), The Hong Kong Institution of Engineers-the Structural Division. (Fig. 2.30)
4. Dr. Wen-Qiang Liu, Outstanding Associate Editor Award 2022, IEEE Transactions on Instrumentation and Measurement. (Fig. 2.31)
5. Recipient of the excellent paper award, the 25th International Conference on Magnetically Levitated System and Linear Drives (Maglev 2022) (Su-Mei Wang, Qi Zhu, Yi-Qing Ni, and Jun-Qi Xu. (October 17-19, 2022), "Experimental study on dynamic performance of medium and low speed maglev train running on the turnout"). (Fig. 2.32)
6. Recipient of the first prize, the Second International Structural Health Monitoring Competition (IC-SHM, 2021), 2022 (En-Ze Rui, Wen-Qiang Liu, Lei Yuan, Si-Yi Chen, and You-Liang Zheng. (July 5, 2022), "A novel computer vision-based vibration measurement and damage assessment method for truss bridges"). (Fig. 2.33)
7. Recipient of the "Excellent Project" award team, "Strengthening Learning Innovation and Creative Competition" (Qi Zhu, and Yang Lu. (November 3, 2022), "Maglev suspension control based on Reinforcement Learning"). (Fig. 2.34)
8. Yi-Qing Ni, Siu-Kai Lai, You-Wu Wang, and Chao Zhang, "A new design of bumpers embedded with high damping materials for bogie frame of high-speed trains", Germany

Utility Model No. 202022104138, Issued on August 3, 2022. (Fig. 2.35)

9. Yi-Qing Ni, Siu-Kai Lai, You-Wu Wang, and Chao Zhang, “A new design of bumpers embedded with high damping materials for bogie frame of high-speed trains”, Japanese Utility Model No. 2022-002494, Issued on September 15, 2022. (Fig. 2.36)
10. Sajjadi Alehashem Seyed Masoud, Yi-Qing Ni, Chih-Shiuan Lin, and Chao Zhang, “A novel methodology for vibration and noise control using modular rail particle damper in rail transit systems”, Chinese Patent No. ZL 202110466428.5, Issued on January 25, 2022. (Fig. 2.37)
11. Sajjadi Alehashem Seyed Masoud, Yi-Qing Ni, Chih-Shiuan Lin, and Chao Zhang, “Modular rail particle damper (MRPD) and damper’s fixture for noise and vibration mitigation of railways”, Chinese Utility Model No. ZL 2021209083522.2, Issued on January 25, 2022. (Fig. 2.38)
12. You-Wu Wang, Yi-Qing Ni, Jia-Ju He, You-Dong Liang, and Jia Xu, “An intelligent power supply free monitoring method for the arch deformation of ballastless track slab”, Chinese Utility Model No. ZL 202223379680.1, Issued on January 5, 2023. (Fig. 2.39)
13. Sajjadi Alehashem Seyed Masoud, Yi-Qing Ni, and Chao Zhang, “Novel methodology for vibration and noise control using modular rail particle damper in rail transit systems”, American Patent submitted, Application No. US 2022/034912 7.
14. You-Wu Wang, Yi-Qing Ni, Jia-Ju He, You-Dong Liang, and Jia Xu, “An intelligent power supply free monitoring method for the arch deformation of ballastless track slab”, Chinese Patent submitted.
15. You-Wu Wang, Yi-Qing Ni, and You-Liang Zheng, “A fault diagnosis device for high-speed train bearings based on trackside acoustics”, Chinese Patent submitted.
16. You-Wu Wang, Yi-Qing Ni, and You-Liang Zheng, “A fault diagnosis device for high-speed train bearings based on trackside acoustics”, Chinese Utility Model submitted.



中国振动工程学会文件

中振字〔2022〕31号

关于表彰2022年度中国振动工程学会科学技术奖获奖项目、2022年度中国振动工程学会青年科技奖和首届中国振动工程学会国际学术贡献奖获奖者的决　定

2022-KJ-1-008	桥梁结构振动疲劳性能劣化机理与精准维护关键技术及工程应用	一等	工程应用	1. 叶肖伟 2. 万华平 3. 倪一清 4. 任伟新 5. 揭志羽 6. 苏有华 7. 陆军 8. 叶建龙 9. 陈斌 10. 乔仲发 11. 李丹 12. 孙震 13. 金涛 14. 丁杨	1. 浙江大学 2. 香港理工大学 3. 深圳大学 4. 宁波大学 5. 苏交科集团股份有限公司 6. 浙江省交通集团检测科技有限公司 7. 中城建勘（浙江）检测科技有限公司

Fig. 2.28 The First Prize Award of Science and Technology, China Vibration Engineering Society, 2022

Fig. 2.29 Prof. Song-Ye Zhu, Fellow of Hong Kong Institution of Engineers, 2022

Fig. 2.30 Prof. Song-Ye Zhu, The HKIE Structural Division Excellence Award 2022 (R&D Award), The Hong Kong Institution of Engineers-the Structural Division

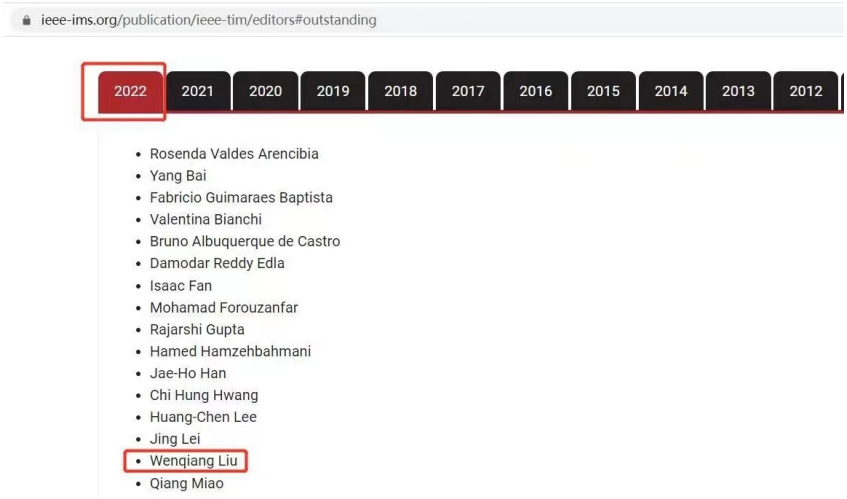


Fig. 2.31 Dr. Wen-Qiang Liu, Outstanding Associate Editor Award 2022, IEEE Transactions on Instrumentation and Measurement

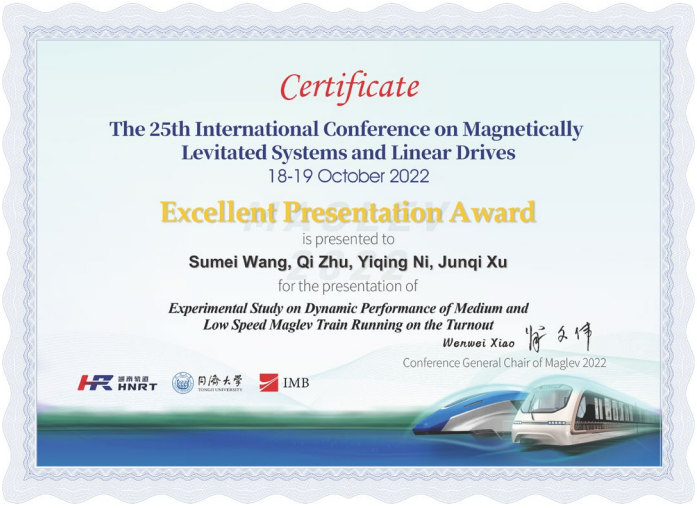


Fig. 2.32 Excellent Presentation Award of the 25th International Conference on Magnetically Levitated System and Linear Drives (Maglev 2022)

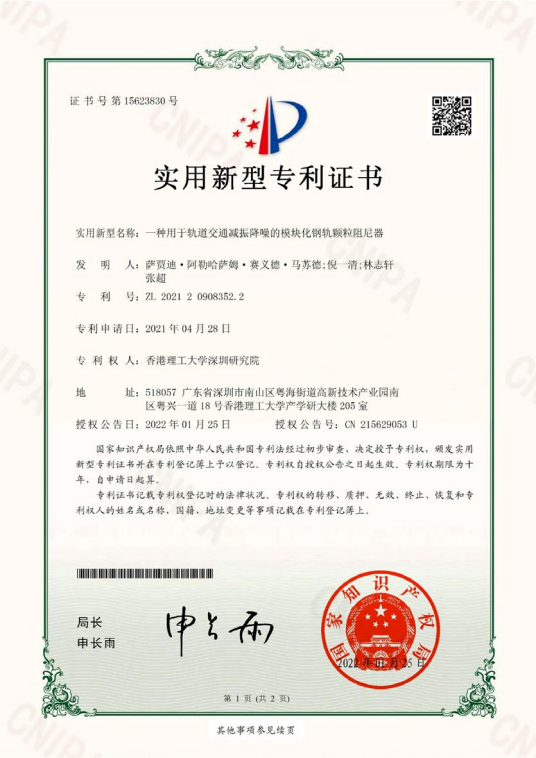
Fig. 2.33 The First Prize of the Second International Structural Health Monitoring Competition (IC-SHM, 2021), 2022

Fig. 2.34 The “Excellent Project” award team of Strengthening Learning Innovation and Creative Competition, 2022

Fig. 2.35 Authorized patent: A new design of bumpers embedded with high damping materials for bogie frame of high-speed trains

Fig. 2.36 Authorized patent: A new design of bumpers embedded with high damping materials for bogie frame of high-speed trains

Fig. 2.37 Authorized patent: A novel methodology for vibration and noise control using modular rail particle damper in rail transit systems



证书号第15623830号

实用新型专利证书

实用新型名称：一种用于轨道交通减振降噪的模块化钢轨颗粒阻尼器

发　明　人：萨贾迪·阿勒哈萨姆·赛义德·马苏德；倪一清；林志轩；张超

专　利　号：ZL 2021 2 0908352.2

专利申请日：2021年04月28日

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

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第 1 页 (共 2 页)

其他事项参见续页

Fig. 2.38 Authorized patent: Modular Rail Particle Damper and Damper's Fixture for Noise and Vibration Mitigation of railways

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谢松(0755-26406581)

发文日：
2023年01月05日

申请号或专利号：202223379680.1　　发文序号：2023010100678050

申请人或专利权人：香港理工大学深圳研究院

发明创造名称：一种智能免供电无砟轨道板上拱变形状态监测系统

授予实用新型专利权通知书

1. 根据专利法第四十条及实施细则第五十四条的规定，上述实用新型申请经初步审查，没有发现驳回理由，现作出授予实用新型专利权的通知。
申请人收到本通知书后，还应当按照办理登记手续通知书的规定办理登记手续。
申请人办理登记手续后，国家知识产权局作出授予实用新型专利权的决定，颁发相应的专利证书，同时予以登记和公告。
期满未办理登记手续的，视为放弃取得专利权的权利。
法律、行政法规规定相应技术的实施应当办理批准、登记等手续的，应依照其规定办理。

2. 授予专利权的实用新型专利申请是以申请人于申请日2022年12月16日提交的文本为基础。

3. 审查员依职权修改内容为：
注：在本通知书发出后收到的申请人主动修改的申请文件，不予考虑。

审 查 员：张梦欣　　审查部门：实用新型审查部

联系电话：010-62087252

220901 2020.3　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
电子申请，应当通过电子专利申请系统以电子文件形式提交相关文件。除另有规定外，以纸件等其他形式提交的文件视为未提交。

Fig. 2.39 Authorized patent: An intelligent power supply free monitoring method for the arch deformation of ballastless track slab

2.3.5 Professional Activities

1. Yi-Qing Ni, Co-Editor-in-Chief of Journal of Infrastructure Intelligence and Resilience (Publisher: Elsevier); (Fig. 2.40)
2. Yi-Qing Ni, Co-Editor-in-Chief of Intelligent Transportation Infrastructure (Publisher: Oxford University Press); (Fig. 2.41)
3. Yi-Qing Ni, Guest Editor for a special issue on "Structural Monitoring Using Advanced NDT Techniques" in Applied sciences, 2022; (Fig. 2.42)
4. Yi-Qing Ni, Guest Editor for a special issue on "AI Empowered and Intelligent Sensors in Structural Health Monitoring and Intelligent Transportation Systems for Current Assessment" in Measurement: Sensors, 2023; (Fig. 2.43)
5. Yi-Qing Ni, Member of International Advisory Board of the 8th International Conference on Structural Engineering, Mechanics and Computation, September 5-7, 2022, Cape Town, South Africa; (Fig. 2.44)
6. Yi-Qing Ni, Member of Conference Editorial Board of the 5th International Conference on Railway Technology: Research, Development and Maintenance, August 22-25, 2022, Montpellier, France; (Fig. 2.45)
7. Yi-Qing Ni, Member of International Scientific Committee of the 10th European Workshop on Structural Health Monitoring, July 4-7, 2022, Palermo, Italy; (Fig. 2.46)
8. Yi-Qing Ni, Member of International Advisory Board of the 15th International Conference on Modern Materials and Technologies Symposium FO: Embodying Intelligence in Structures and Integrated Systems, June 25-29, 2022, Perugia, Italy;
9. Yi-Qing Ni, Member of International Scientific Committee of the 8th World Conference on Structural Control and Monitoring, June 5-8, 2022, Orlando, Florida, USA; (Fig. 2.47)
10. Song-Ye Zhu, Editor of Advances in Structural Engineering (Publisher: SAGE); (Fig. 2.48)
11. Song-Ye Zhu, Associate Editor of International Journal of Smart and Nano Materials (Publisher: Taylor & Francis); (Fig. 2.49)
12. Zhong-Qing Su, Editor-in-Chief of Journal of Ultrasonics (Publisher: Elsevier); (Fig. 2.50)
13. Ka-Wai Cheng, Chief Editor of Journal of Frontier Industrial Electronics (Publisher: Frontiers); (Fig. 2.51)

14. Ka-Wai Cheng, Associate Editor of Journal of IEEE Transactions on Industrial Electronics (Publisher: IEEE Industrial Electronics Society); (Fig. 2.52)
15. Ka-Wai Cheng, Associate Editor of Journal of IET Power Electronics (Publisher: Wiley); (Fig. 2.53)
16. Siu-Kai Lai, Associate Editor of Journal of Vibration Engineering & Technologies (Publisher: Springer); (Fig. 2.54)
17. Wen-Qiang Liu, Guest Editor for a special issue on "Emerging Signal Processing Technologies in Industrial Automation and Control" in IET Signal Processing, 2022. (Fig. 2.55)

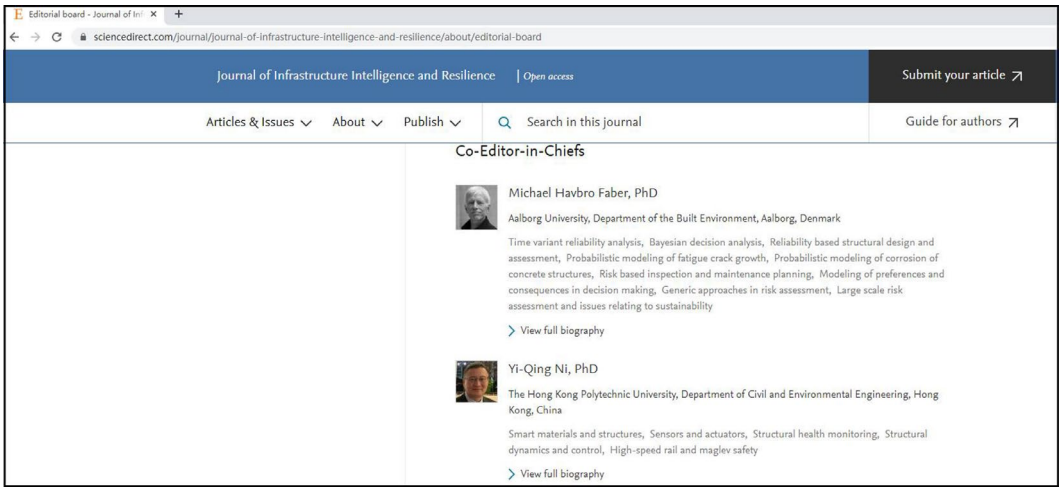


Fig. 2.40 Prof. Yi-Qing Ni, Appointed as Co-Editor-in-Chief of Journal of Infrastructure Intelligence and Resilience

Fig. 2.41 Prof. Yi-Qing Ni, Appointed as Co-Editor-in-Chief of Intelligent Transportation Infrastructure

Fig. 2.42 Prof. Yi-Qing Ni, Appointed as Guest Editor for a special issue on "Structural Monitoring Using Advanced NDT Techniques" in Applied sciences, 2022

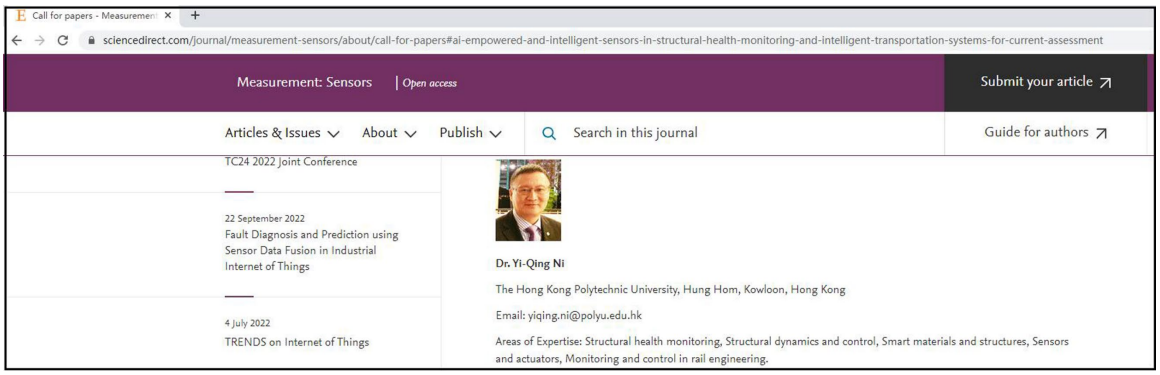


Fig. 2.43 Prof. Yi-Qing Ni, Appointed as Guest Editor for a special issue on "AI Empowered and Intelligent Sensors in Structural Health Monitoring and Intelligent Transportation Systems for Current Assessment" in Measurement: Sensors, 2023

Fig. 2.44 Prof. Yi-Qing Ni, Member of International Advisory Board of the 8th International Conference on Structural Engineering, Mechanics and Computation, September 5-7, 2022, Cape Town, South Africa

Fig. 2.45 Prof. Yi-Qing Ni, Member of Conference Editorial Board of the 5th International Conference on Railway Technology: Research, Development and Maintenance, August 22-25, 2022, Montpellier, France

Fig. 2.46 Prof. Yi-Qing Ni, Member of International Scientific Committee of the 10th European Workshop on Structural Health Monitoring, July 4-7, 2022, Palermo, Italy

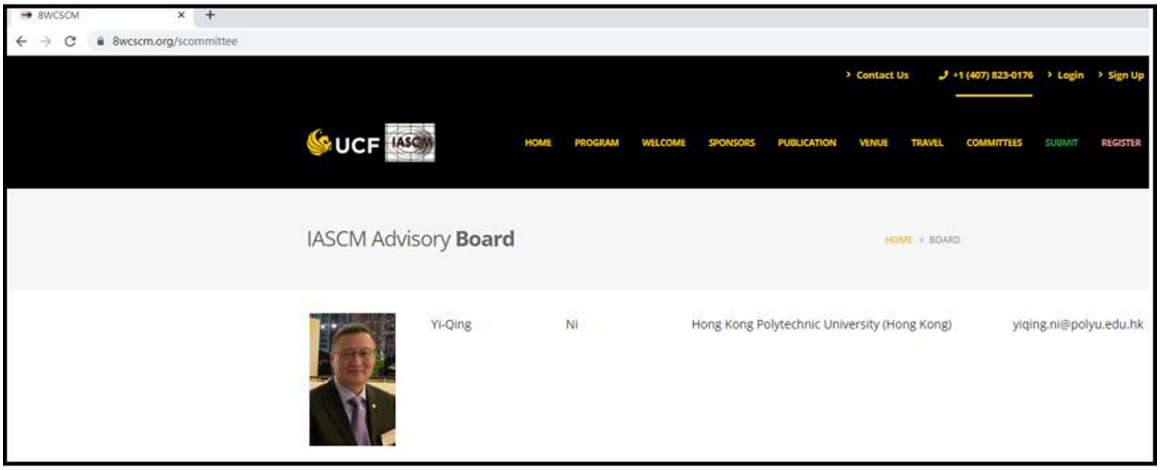


Fig. 2.47 Prof. Yi-Qing Ni, Member of International Scientific Committee of the 8th World Conference on Structural Control and Monitoring, June 5-8, 2022, Orlando, Florida, USA

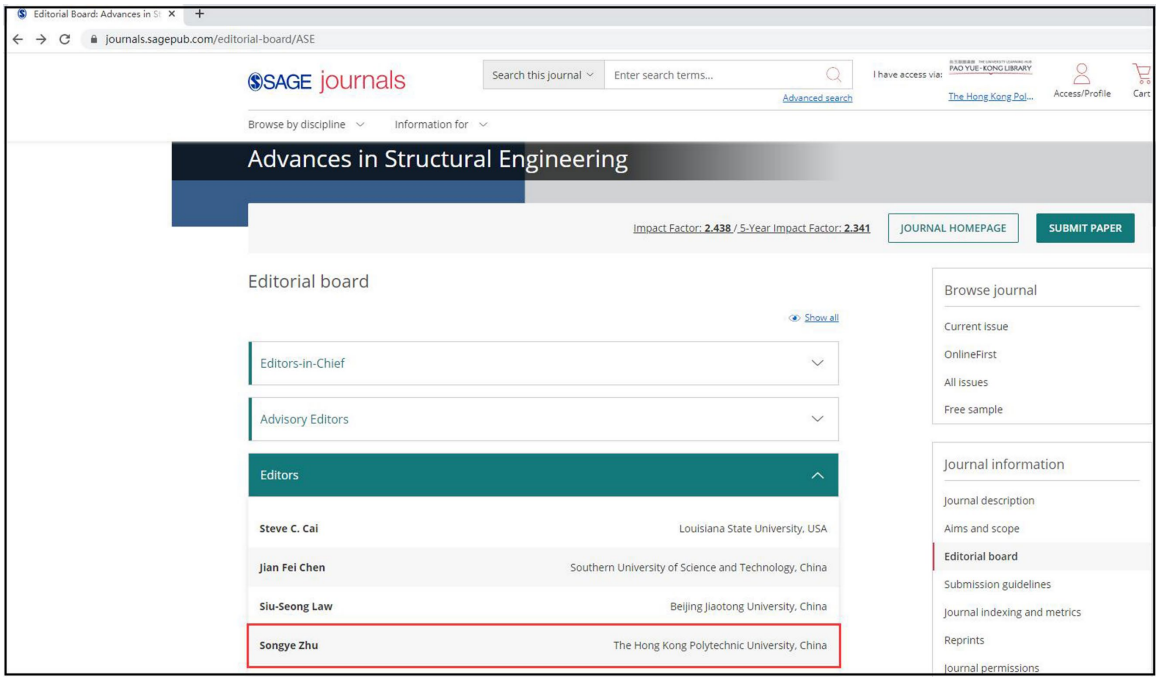


Fig. 2.48 Prof. Song-Ye Zhu, Appointed as Editor of Advances in Structural Engineering

Fig. 2.49 Prof. Song-Ye Zhu, Appointed as Associate Editor of International Journal of Smart and Nano Materials

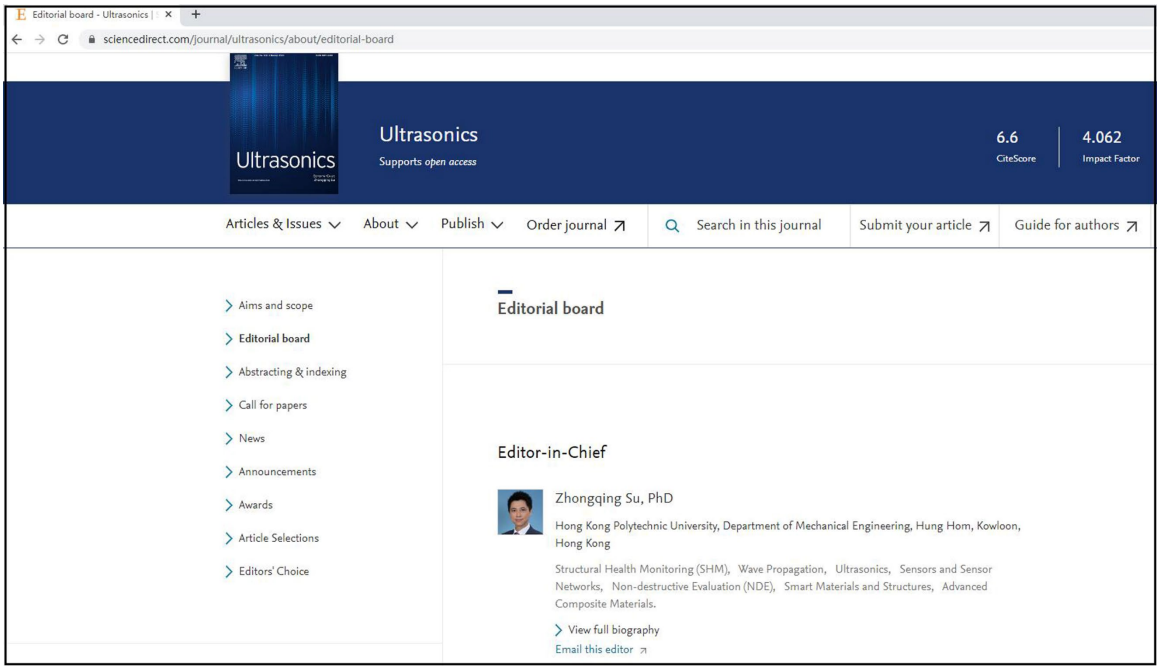


Fig. 2.50 Prof. Zhong-Qing Su, Appointed as Editor-in-Chief of Journal of Ultrasonics

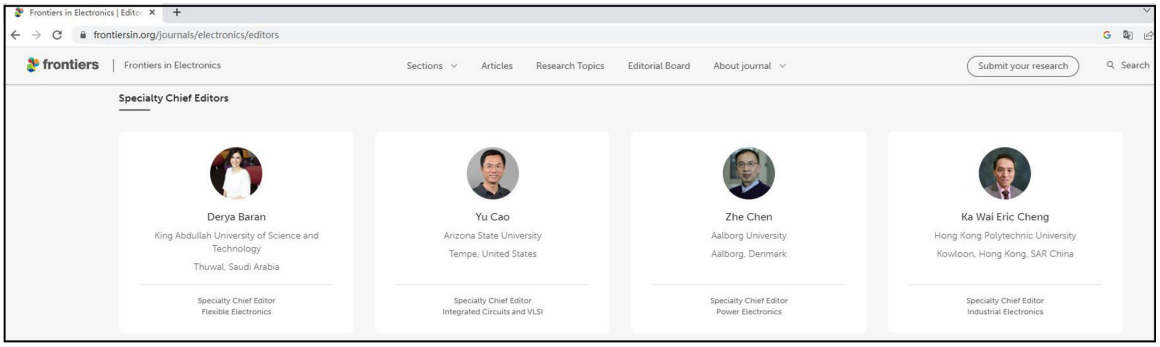


Fig. 2.51 Prof. Ka-Wai Cheng, Appointed as Chief Editor of Journal of Frontier Industrial Electronic

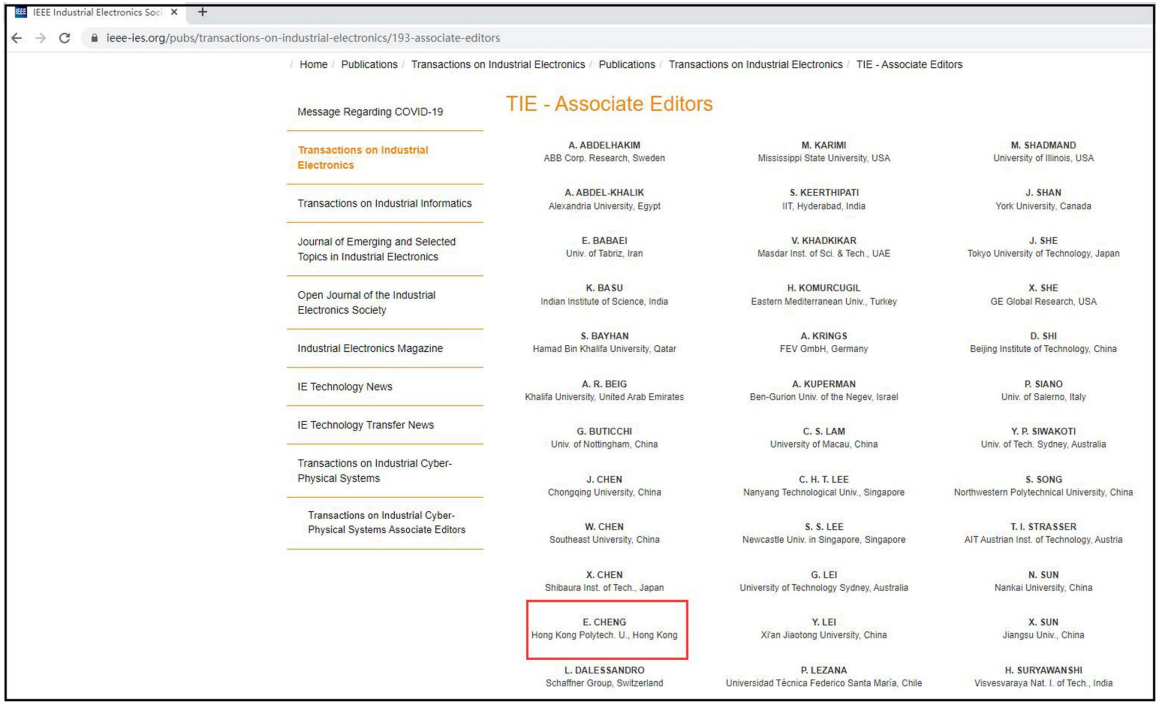


Fig. 2.52 Prof. Ka-Wai Cheng, Appointed as Associate Editor of Journal of IEEE Transactions on Industrial Electronics

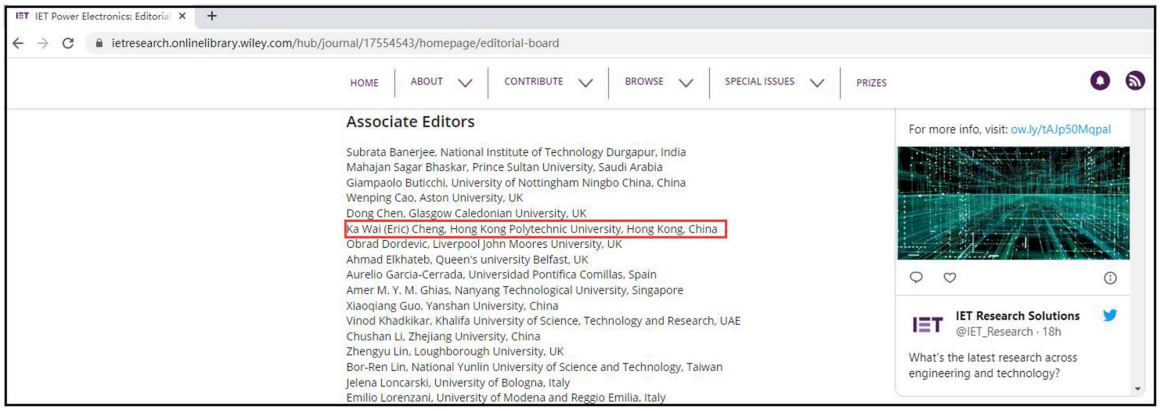


Fig. 2.53 Prof. Ka-Wai Cheng, Appointed as Associate Editor of Journal of IET Power Electronics

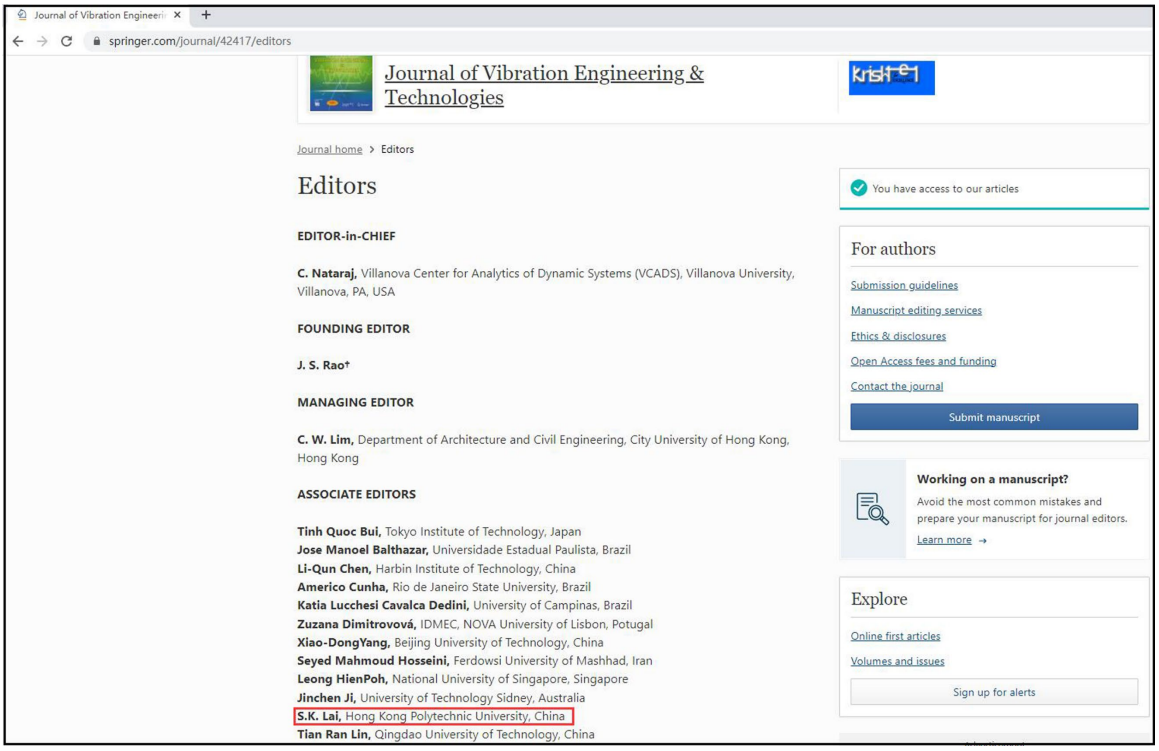
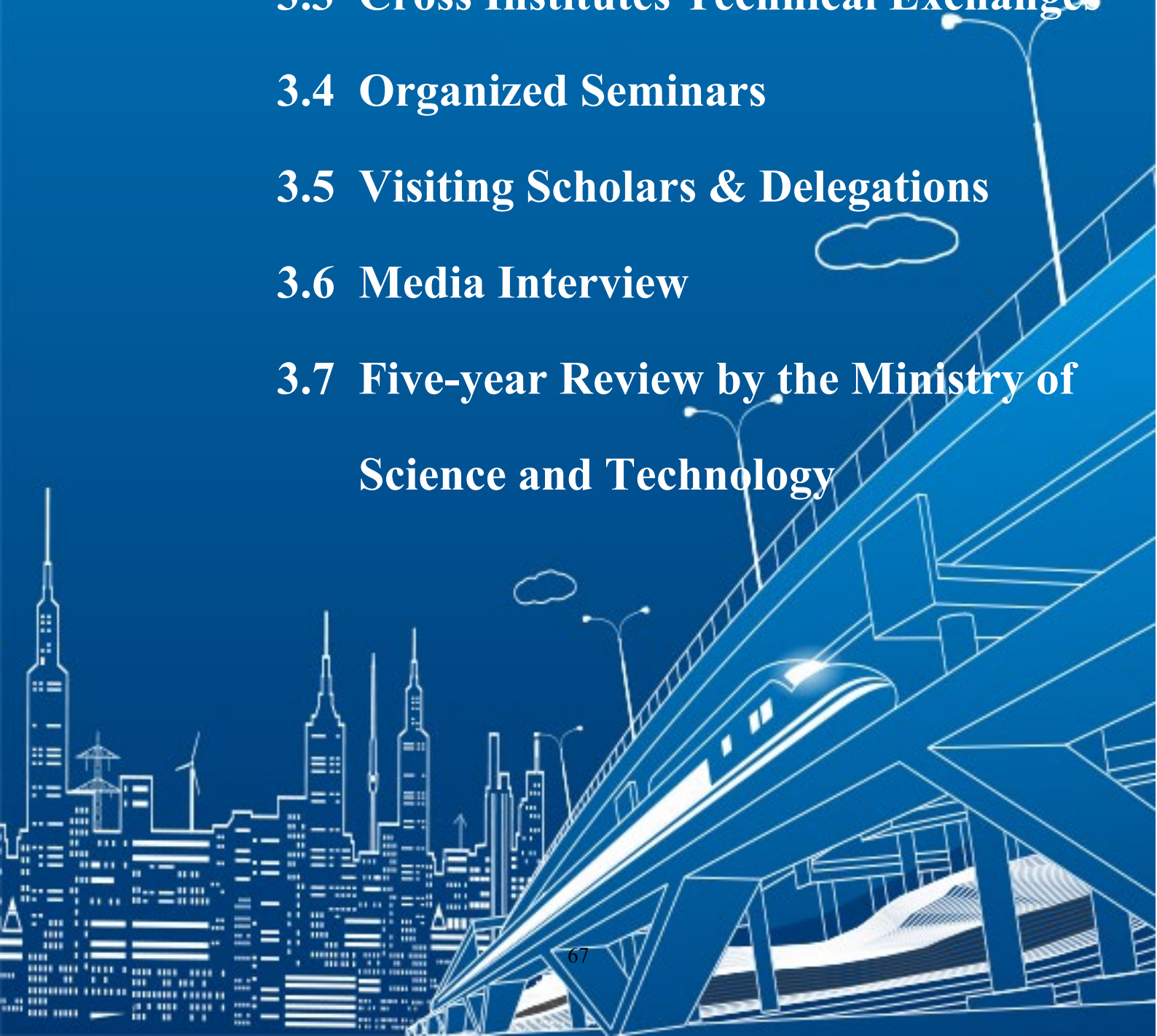


Fig. 2.54 Dr. Siu-Kai Lai, Appointed as Associate Editor of Journal of Vibration Engineering & Technologies

Fig. 2.55 Dr. Wen-Qiang Liu, Appointed as Guest Editor for a special issue on “Emerging Signal Processing Technologies in Industrial Automation and Control” in IET Signal Processing, 2022

3. Collaborations & Exchanges



3. Collaborations & Exchanges

3.1 Collaboration Agreements

Under the Research Grants Council's Research Impact Fund (RIF) Research Scheme, CNERC-Rail (HK Branch) is leading a Research Impact Fund project entitled "Enhancing Safety, Punctuality and Ride Comfort of Railway Transportation: From Local Metro to Global High-speed Rail Network". This project lasts 48 months, from June 1, 2019 to May 31, 2023. In total, a budget of HKD 8, 437, 600 was approved for this project. The fund came from four different sources. Research Grants Council provided HKD 5, 892, 320, PolyU provided a matching fund of HKD 1, 445, 280, City University of Hong Kong provided HKD 600, 000, and China SWJTU Railway Development Co., Ltd., provided a matching fund of HKD 500, 000.

3.1.1 Memorandum of Understanding of Cooperation Between MTR Corp Ltd, MTR Academy and The Hong Kong Polytechnic University

On June 14, 2022, MTR Corp Ltd and MTR Academy signed a memorandum understanding of cooperation with the Hong Kong Polytechnic University to establish a partnership in promoting railway technology. The three-year cooperation plan focuses on the research and development of advanced and innovative railway technology, and promote intelligent railway asset management in particular intelligent maintenance. The memorandum is a framework for the three parties to discuss innovative scheme and technology applications. With the expertise of MTR Corp Ltd and MTR Academy in railway, as well as the strength of PolyU in intelligent railway technology, intelligent remote sensing technology can be further used to improve the performance of railway operation and intelligent maintenance. The scope of cooperation includes exploring smart solutions for monitoring railway assets and evaluating asset status, exploring the establishment of a joint laboratory for railway science and technology applications, and conducting research projects related to improvement the operating environment of train services, such as station flow management, etc.

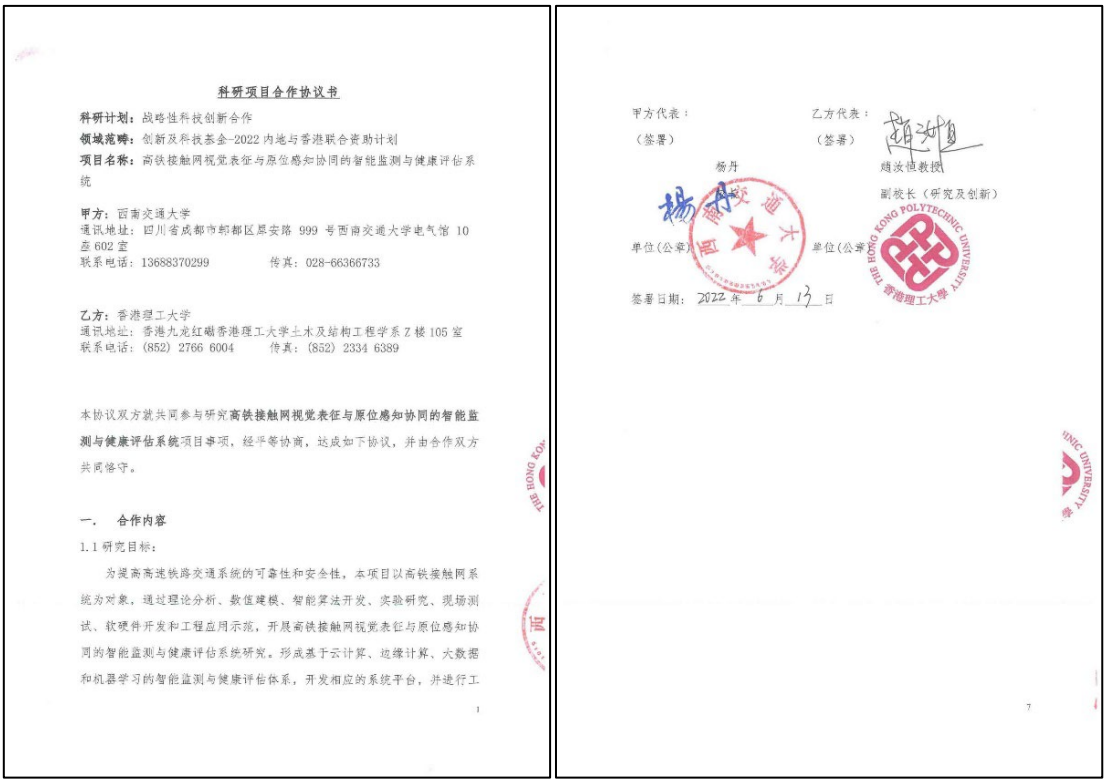
The memorandum was signed by Ze-Pei Jin, Chief Executive Officer of MTR Corp Ltd, Hui-Zhen Zheng, President of MTR Academy, Jin-Guang Teng, President of PolyU, and Ru-Heng Zhao, Vice President (Research and Innovation) of PolyU, under the witness of Bo-Quan Ouyang, President of MTR Corp Ltd, and Da-Hui Lin, President of PolyU Council; Professor

Yi-Qing Ni, Director of CNERC-Rail (HK Branch), also attended the signing ceremony (Fig. 3.1).

Fig. 3.1 Memorandum of understanding signing ceremony between MTR Corp Ltd, MTR Academy and the Hong Kong Polytechnic University

3.1.2 Cooperation Agreement with Southwest Jiaotong University

On June 13, 2022, CNERC-Rail (HK Branch) of Hong Kong Polytechnic University and Southwest Jiaotong University signed a cooperation agreement on strategic scientific and technological innovation research projects (Fig. 3.2), to jointly apply for the first batch of Hong Kong, Macao and Taiwan projects under the key special project of “strategic scientific and technological innovation cooperation” in 2022, The project name is “Intelligent Detection and Health Assessment System of Visual Representation and In Situ Perception of High speed Railway OCS”. The two sides intend to make full use of their respective advantages in research to enhance the reliability and safety of high-speed railway transportation system together through this project, and strive to expand the depth and breadth of bilateral cooperation in relevant fields, so as to achieve more social and economic benefits through promoting technological advancement and their application in high-speed railway transportation. The agreement will be valid from the date of approval of the project application to the end of the project, with a subsidy of 2.6999 million Hong Kong dollars.



科研项目合作协议书

科研计划： 战略性科技创新合作

领域范畴： 创新及科技基金--2022 内地与香港联合资助计划

项目名称： 高铁接触网视觉表征与原位感知协同的智能监测与健康评估系统

甲方： 西南交通大学
通讯地址：四川省成都市郫都区犀安路 999 号西南交通大学电气馆 10 座 602 室
联系电话：13688370299　　传真：028-66366733

乙方： 香港理工大学
通讯地址：香港九龙红磡香港理工大学土木及结构工程学系 Z 楼 105 室
联系电话：(852) 2766 6004　　传真：(852) 2334 6389

本协议双方就共同参与研究**高铁接触网视觉表征与原位感知协同的智能监测与健康评估系统**项目事项，经平等协商，达成如下协议，并由合作双方共同恪守。

一、 合作内容

1.1 研究目标：

为提高高速铁路交通系统的可靠性和安全性，本项目以高铁接触网系统为对象，通过理论分析、数值建模、智能算法开发、实验研究、现场测试、软硬件开发和工程应用示范，开展高铁接触网视觉表征与原位感知协同的智能监测与健康评估系统研究。形成基于云计算、边缘计算、大数据和机器学习的智能监测与健康评估体系，开发相应的系统平台，并进行工

甲方代表：　　乙方代表：
（签署）　　（签署）
杨丹　　赵汝恒教授
副校长（研究及创新）
单位（公章）　　单位（公章）
签署日期：2022 年 6 月 17 日

Fig. 3.2 Cooperation agreement for the first batch of Hong Kong, Macao and Taiwan projects under the "strategic science and technology innovation cooperation" key special project in 2022

3.1.3 Cooperation Agreement with Hunan Railway Vehicle Bogie Engineering Technology Research Center

In June 2022, CNERC-Rail (HK Branch) of the Hong Kong Polytechnic University and the Engineering Technology Research Center for Railway Vehicle Bogies of Hunan Province signed a cooperation agreement on the development of composite ATC antenna beam self sensing technology and application research (Fig. 3.3). The two sides intend to make full use of their respective advantages in pursuing cooperation in theoretical and application researches, knowledge and personnel exchanges and other aspects related to composite ATC antenna beam self sensing technology, and to strive to expand the depth and breadth of cooperation in relevant fields in particular, so as to achieve more social and economic benefits (the application of health detection technology in the field of rail transit). The agreement is valid for 3 years from June 1, 2022 to May 31, 2025.

中国中车 CRRC
湖南省轨道车辆转向架工程技术研究中心

THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

湖南省轨道车辆转向架工程技术研究中心
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
关于开展复合材料 ATC 天线梁自感知技术和应用研究的合作协议

2022 年 06 月

中国 · 株洲

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4.1.3 除非另有约定，根据合作协议开展具体合作时所签署的进一步的具有具体权利义务的协议，将被视为对每一方都具有法律约束力的文件。

5 附 则

5.1 协议的生效与终止

5.1.1 本合作协议自双方授权代表签字或盖章之日起生效。

5.1.2 本合作协议有效期 3 年，自 2022 年 6 月 1 日起至 2025 年 5 月 31 日止。

5.1.3 与本协议相关的附件、备忘录等与本协议拥有同等的法律效力。

5.1.4 任何一方提出，经参与方共同协商一致后，可终止或延期本协议。

5.2 其他

5.2.1 本合作协议一式肆份，各参与方各持贰份。

合作签字盖章

湖南省轨道车辆转向架工程技术研究中心

代表签字：

姓名：滕素红 副总工

职位：主任

日期：2022-07-29

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

代表签字：

姓名：倪一清 讲座教授

职位：主任

日期：2022 年 6 月 1 日

5 / 5

Fig. 3.3 Cooperation agreement with Hunan Railway Vehicle Bogie Engineering Technology Center on research of composite ATC antenna beam self sensing technology and application research

3.1.4 Cooperation Agreement with Jiangsu University

On December 6, 2022, CNERC-Rail (HK Branch) of Hong Kong Polytechnic University signed a cooperation agreement on making joint application of scientific research projects with Jiangsu University (Fig. 3.4) under the improvement both universities will jointly apply for a progress under the “2023 Jiangsu Science and Technology Plan Special Fund (Innovation Support Plan International Science and Technology Cooperation Hong Kong Macao Taiwan Science and Technology Cooperation) Project”. The project title is “Joint research and development of key technologies on the dual motor integrated electric drive assembly for new energy commercial vehicles”. The two sides intend to make full use of their respective advantages in pursuing cooperation in theoretical and application research, knowledge and personnel exchanges and other aspects related to integrated electric drive assembly of new energy commercial vehicles based on intelligent networking platform, so as to achieve more social and economic benefits. Both sides will jointly promote technological advancement and their applications in the field of new energy commercial vehicles. The project is valid for 3 years from April 2023 to March 2026.

科研项目联合申报合作协议

甲方：江苏大学
地址：中国江苏省，镇江市，京口区，学府路 301 号

乙方：香港理工大学
地址：中国香港特别行政区，九龙，红磡，育方路，香港理工大学

申报项目名称：新能源商用车双电机一体化电驱动总成关键技术的联合研发

甲乙双方就合作及共同申请"2023 年度江苏省科技计划专项资金（创新支撑计划国际科技合作港澳台科技合作）项目"，经友好协商，甲方为项目的申报单位，乙方为项目的境外合作单位。经各方充分协商一致，达成如下协议：

1 项目负责人和项目合作负责人
甲方：三　峰(项目负责人)
乙方：兄一清(项目合作负责人)

2 协议有效期
本协议自双方法定或受权代表人签字并公章之日起生效，除了本协议第 9.2、9.3 及 9.4 项的例外情况，本协议有效期至本项目完成之日止或本协议生效日起计五年止，两者以较早者为准。

3 职责分工
3.1 甲方负责项目的总体组织与实施，具体包括：新能源商用车一体化电驱动总成构型方案设计；基于智能网联平台的 eDMT 低能耗优化控制技术；eDMT 换模过程宽域扭振抑制；组织项目成员的产学研合作及转化。
3.2 乙方负责协助甲方进行新能源商用车 eDMT 总成核心算法设计，具体包括：eDMT 核心部件可靠性提升算法、车载试制模块与阿联 V2X 信息数据传输信息挖掘算法；eDMT 宽频扭振主动抑制算法。

4 知识产权归属及收益分配

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校长
日期：

香港理工大学
公章
受权代表人签字：
李秀乐
副院长及环境学院院长
日期：

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职称：汽车工程研究院副教授
联系方式：+86 17625115808
日期：2022 年 12 月 06 日

香港理工大学
项目合作负责人(签字)：
姓名：倪一清
职称：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
联系方式：yiqing.ni@polyu.edu.hk
日期：2022 年 12 月 06 日

Fig. 3.4 Cooperation agreement with Jiangsu University on joint research and development of key technologies for dual motor integrated electric drive assembly of new energy commercial vehicles

3.2 Presentations

3.2.1 The 5th International Workshop on Seawater Sea-sand Concrete (SSC) Structures Reinforced with FRP Composites

To combat the deterioration of concrete structures in coastal/marine environments due to the corrosion of steel, the use of fibre-reinforced polymer (FRP) to replace steel reinforcement in concrete structures has attracted significant attention and is gaining increasing acceptance. As FRP is expected to be little affected by chloride ions, its application in concrete structures opens a new avenue for concrete production with the direct use of locally available seawater and sea-sand. The resulting structures, referred to as FRP-reinforced seawater sea-sand concrete (FRP-SSC) structures, offer compelling economic and environmental advantages through savings in freshwater and material transportation costs as well as reduced river-sand mining. The bright prospects of FRP-SSC structures in the development of sustainable civil infrastructure have kindled growing research interests on relevant topics among researchers worldwide. The FRP-SSC Structures Workshop series was initiated against this background and has now become an annual event.

From January 15 to 16, 2022, the Director of CNERC-Rail (HK Branch) Prof. Yi-Qing Ni attended the “5th International Workshop on Seawater Sea-sand Concrete (SSC) Structures Reinforced with FRP Composites” organized by the Department of Civil and Environmental Engineering & Research Institute for Sustainable Urban Development of the PolyU. Prof. Yi-Qing Ni and Mr. Zhen Lin, a member from CNERC-Rail (HK Branch), gave an online presentation on the “Wireless Optical Fibre-based Humidity Sensor System for Seawater Sea-sand Concrete”. (Fig. 3.5)

Fig. 3.5 Presentation of Prof. Yi-Qing Ni and Mr. Zhen Lin

3.2.2 International Meet on Electronics and Electrical Engineering (EEEMEET2022)

EEEMEET2022 was held online during March 21 to 23, 2022. EEEMEET2022 provided a platform of international standards to discuss and share persuasive key advances in electronics and electrical engineering. In addition to Presentations, Workshops, and Discussions, the conference also offered a unique venue for renewing professional relationships, networking, and remaining up-to-date variations in our challenging and expanding discipline.EEEMEET2022 not only increased the number of opportunities for you to network with colleagues from across the world but also introduced more focused sessions that will feature cutting-edge presentations, special panel discussions, and livelier interaction with industry leaders and experts. Professor Ka-Wai Cheng, a key-member of CNERC-Rail (HK Branch), was invited to present a keynote speech on “Electric Vehicles and its Impact to Energy Storage”.

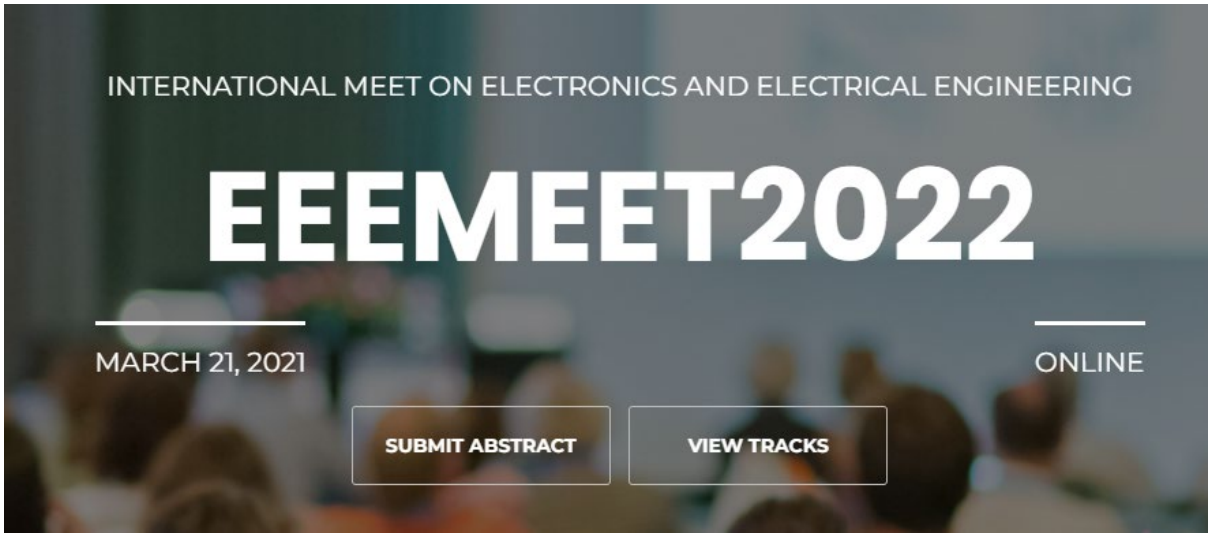


Fig. 3.6 Keynote speech on "Electric Vehicles and its Impact to Energy Storage" at EEEMEET2022

3.2.3 Intelligent Track Infrastructure Safety Congress 2022

The Intelligent Track Infrastructure Safety Congress 2022 was an online event which took place from March 29 to 30, 2022. The event, organized by the London Business Conferences Group (LBCG), aimed to compare strategic perspectives on implementing new monitoring technology to improve safety within the global rail industry. The virtual event addressed relevant industry questions, such as how to predict failures and forecast when to intervene, using improved data interpretation and visualization technology.

A key member of CNERC-Rail (HK Branch), Prof. Kang-Kuen LEE, delivered an "Investment Case for Monitoring Track Conditions" covering track condition monitoring methods, a fully automated and continuous track condition monitoring system, predictions of track conditions, and Industry 4.0/ Maintenance 4.0. A case study on Train Track Condition Monitoring (TTCM) System in Singapore was also shared.

Fig. 3.7 Intelligent Track Infrastructure Safety Congress 2022

3.2.4 The 88th PolyU Research Salon

The 88th PolyU Research Salon organized by the Research and Innovation Office of The Hong Kong Polytechnic University was successfully held on April 20, 2022. The theme of this salon was to explore the overall development of the Lok Ma Chau Loop area. PolyU Vice-President (Research and Innovation) Prof. Ru-Heng Zhao and PolyU Director of Research and

Innovation Office Prof. Ming-Xiang Zhou delivered welcome speeches. Mr. Chi-Hong Xiao, Chief Executive Officer of the Hong Kong-Shenzhen Innovation and Technology Park (HSITP), shared the strategic role of the Loop area in the Mainland and the importance of regional development, the "One Zone, Two Parks" support plan, and the "Life and Health Innovation Research Center" and other details.

To end, there was a discussion session, chaired by Prof. Ru-Heng Zhao, with the participations of Prof. Kwok-Yin Wong, Vice President (Education) of PolyU, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), Mr. Chi-Hong Xiao, and Ms. Qi-Cui Gan, Chief Operation Officer of HSITP. Through this salon, the PolyU scientific research team represented by CNERC-Rail (HK Branch) will participate more deeply in the development and construction of HSITP in the Lok Ma Chau Loop area, responding to the blueprint for the development of innovation and technology by the Hong Kong government, and deepening cooperation with the Mainland Cooperation in innovation and technology to better integrates into the overall development of the country.

Fig. 3.8 Group photo of the 88th PolyU Research Salon

3.2.5 The 8th World Conference on Structural Control and Monitoring (8WCSCM)

8WCSCM was held in Orlando, Florida from June 5 to 8, 2022. The University of Central Florida (UCF) in collaboration with the U.S. Panel of the International Association for Structural Control and Monitoring (IASCM) were the organizers of the international conference. The conference encompassed all aspects of structural control and monitoring for a variety of civil, mechanical, aerospace and energy systems. The program included 8 keynotes

from prominent researchers, 39 breakout sessions with several special sessions organized by experts, several technical sessions in thematic areas (252 papers from 41 countries), and 2 mini-symposia with contributors from academia, industry, and government.

The Director of CNERC-Rail (HK Branch) Prof. Yi-Qing Ni was invited to deliver an online keynote speech on "Physics-informed Machine Learning and Transfer Learning for Structural Health Monitoring and Vibration Control". Other members of CNERC-Rail (HK Branch), including Dr. Wen-Qiang Liu, Mr. Xin Ye, Ms. Si-Yi Chen, Mr. Gao-Feng Jiang, Mr. Yang Lu, Mr. Shuo Hao, Mr. En-Ze Rui, Mr. Qi-Fan Zhou, and Ms. Qi Zhu attended this conference and gave online presentations (Fig. 3.9).

Fig. 3.9 Keynote speech and presentations by members of CNERC-Rail (HK Branch) at 8WCSCM

3.2.6 2nd International Forum of NFEES on Artificial Intelligence and Disaster Prevention and Mitigation (IFNFEES02)

The 2nd International Forum of NFEES on Artificial Intelligence and Disaster Prevention and Mitigation (IFNFEES02) was held via teleconferencing from July 1 to 2, 2022. The theme of the meeting was "Artificial Intelligence and Disaster Prevention and Mitigation". Hosted by the National Facility for Earthquake Engineering Simulation (NFEES) of Tianjin University, the forum was jointly organized by the Innovation Base of Earthquake Engineering

Comprehensive Simulation (IBEECS) project, the Earthquake Engineering and Resilience (EER) journal published by John Wiley & Sons Inc. in partnership with Tianjin University, and the Key Laboratory of Earthquake Engineering Simulation and Seismic Resilience (EESSR) of China Earthquake Administration. The forum featured presentations by nineteen well-known experts and scholars from world leading universities, who shared their latest research results on topics, such as, artificial intelligence, structural health monitoring, disaster prevention and reduction, resilient cities, intelligent structures, and other topics of earthquake engineering and discussed the challenges faced and the scientific problems to be addressed. The scientific exchange greatly promoted the development and application of theories in this field.

Prof. Yi-Qing Ni was invited to deliver a keynote presentation of "Transfer learning, graph neural networks, and physics-informed neural networks and their applications in structural health monitoring and vibration control" at IFNFEES02 (Fig. 3.10).

Fig. 3.10 Prof. Yi-Qing Ni was invited to give a keynote speech "Transfer learning, graph neural networks, and physics-informed neural networks and their applications in structural health monitoring and vibration control"

3.2.7 The 10th European Workshop on Structural Health Monitoring (EWSHM 2022)

EWSHM 2022 took place in Palermo, Italy on July 4-7, 2022. This Workshop represented a forum where experts from around the world discussed the latest advancements and breakthroughs in the field of SHM and more broadly in the fields of nondestructive evaluation, smart materials and intelligent systems. The Workshop fostered the discussion and identification of key and emerging challenges and opportunities in research, development, and field applications. Despite the uncertainties related to COVID19 and political instabilities in many parts of the world, the EWSHM 2022 was the most attended event in the history of the series. There were 500+ oral presentations from nearly 50 different countries.

The Director of CNERC-Rail (HK Branch), Prof. Yi-Qing Ni, was invited to deliver a keynote speech on "Sensing technology meets scientific machine learning: Applications from metro to maglev" (Fig. 3.11).

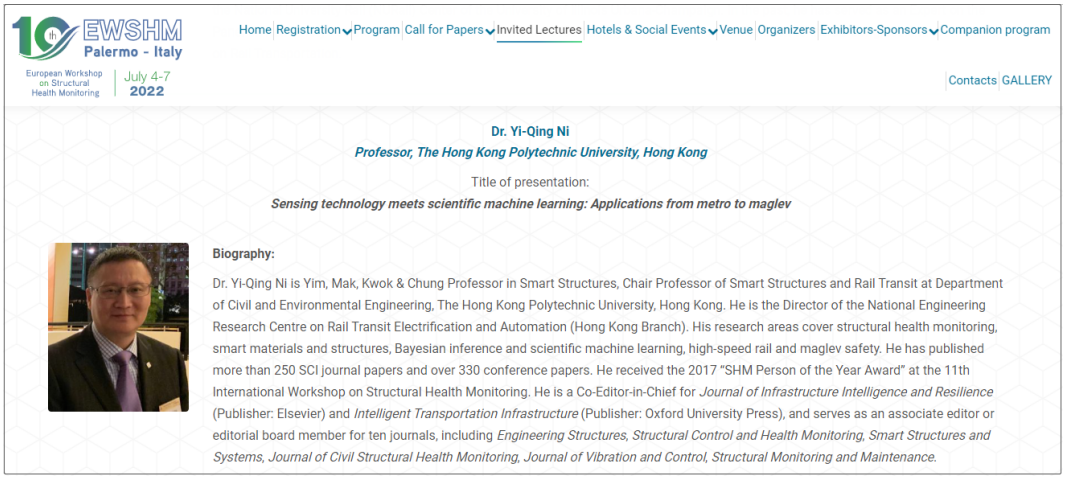


Fig. 3.11 Keynote speech "Sensing technology meets scientific machine learning: Applications from metro to maglev" by Prof. Yi-Qing Ni at EWSHM 2022

3.2.8 The 10th China Maglev Technology Academic Symposium

The 10th China Maglev Technology Academic Symposium was held in Shenyang, Liaoning Province from July 29 to August 1, 2022. The symposium was sponsored by the Chinese Society of Vibration Engineering, hosted by Shenyang University of Technology, co-organized by the Fluid Engineering Branch of the Chinese Mechanical Engineering Society, and supported by the Liaoning Association for Science and Technology. The purpose of the symposium was to explore solutions to key technical problems related to maglev technology and operation through development of measures involving multidisciplinary integration, with cutting-edge crossover, and to identify future direction of innovative applications of maglev technology and means for vibration control. The theme of this symposium was "focusing on the frontier, co-promoting integration in depth and coordinated development of magnetic levitation technology and vibration control in multiple fields". Multiple research directions were involved, around the subjects of magnetic suspension bearings, magnetic suspension transportation, magnetic drive, magnetic vibration isolation and suppression, and other cross-desciplines fields. Mr. Gao-Feng Jiang, a member of CNERC-Rail (HK Branch), attended the symposium and made a report on "Maglev malfunction analysis based on time-frequency spectrogram from rail acceleration data" at the maglev transportation branch (Fig. 3.12).

Fig. 3.12 Mr. Gao-Feng Jiang giving presentation at symposium

3.2.9 2022 2nd International Conference on Power Electronics and Power Transmission (ICPEPT 2022)

ICPEPT 2022 was finally held in Changchun, China from August 19 to 21, 2022. ICPEPT 2022 brought together renowned scholars and industrial experts in the field of power electronics and power transmission to a common forum. The primary goal of the conference was to promote research and development activities in power electronics and power transmission through more active scientific information exchange among researchers, designers, engineers, students, and practitioners working all around the world. The conference is to be held yearly for participants to share knowledge and experiences in power electronics and power transmission and related areas on this platform.

Professor Ka-Wai Cheng, a key-member of the centre, was invited to present a keynote speech “Energy Management, Energy Sources and Power Electronics Techniques for Electric Vehicles” (Fig. 3.13).

Fig. 3.13 Keynote speech "Energy Management, Energy Sources and Power Electronics Techniques for Electric Vehicles" at ICPEPT 2022

3.2.10 The 5th International Conference on Railway Technology Research, Development and Maintenance

Railways have always played a significant role in the development of the wealth creation capabilities of society. The early Roman wagonways, the steam driven railways during the industrial revolution and the electric railways of the late nineteenth and twentieth century are just a few of the railway systems that have played a vital role in past infrastructure development. The exploration for a fast, reliable and cost effective means of transport which presents better energy efficiency and less impact on the environment has resulted in more attention and rapid development for railway technology. The first conference on railway technology research was held in: Las Palmas de Gran Canaria in 2012; the second in Ajaccio, Corsica, in 2014; the third in Cagliari, Sardinia in 2016; and the fourth in Sitges, Barcelona in 2018.

On August 22 to 25, 2022, The Fifth International Conference on Railway Technology Research, Development and Maintenance was held in Montpellier, France. Dr. Zheng-Wei Chen, a member of CNERC-Rail (HK Branch), gave an online presentation entitled "Aerodynamic performance of a train passing through a hillock region beside a windbreak and flow mitigation measures". (Fig. 3.14)

Fig. 3. 14 Dr. Chen's presentation in The Fifth International Conference on Railway Technology Research, Development and Maintenance

3.2.11 The 12th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems（CM2022）

Systems（CM2022）

International Conference on Contact Mechanics and Wear of Rail/Wheel Systems(CM2022) has been one of the core international conferences on railway wheel-rail mechanics area. The CM2022 was held from September 4 to 7, 2022 at Melbourne Convention and Exhibition Centre, and hosted by the Monash Institute of Technology, Australia. The theme of CM 2022 was "Advancing the Science and Practice of the Wheel/Rail Interface to Improve Railway Operation Efficiency". This conference brought together the latest knowledge, practice, and discoveries to achieve an improved understanding of the behaviour and mechanisms of wheel/rail contact and associated phenomena by fundamental scientific research and innovative engineering, operation, and maintenance.

Mr. Yun-Ke Luo, a Ph.D. candidate of CNERC-Rail (HK Branch), attended the noise and vibration session of CM2022. Mr. Luo gave a presentation entitled "To understand the wheel-rail flange squeal through the contact perspective". He further joined the discussion with other participants regarding the flange squeal noise generation mechanism and transient noise modeling technique (Fig. 3.16).

Fig. 3. 15 Topic of presentation by Mr. Yun-Ke Luo at CM2022

Fig. 3. 16 Group photo of CM2022 participants

3.2.12 The 25th International Conference on Magnetically Levitated System and Linear Drives（MAGLEV2022）

From October 18 to 19, 2022, MAGLEV2022 was successfully held in Changsha, China. About 300 experts and scholars from many places participated in the conference through either online or by face to face means. With the theme of “Beautiful Maglev, Intelligent Connected World”, the conference focused on the innovative application of maglev technology which demonstrated the achievements in maglev transportation engineering. The conference effectively promoted the integration and development of international elements, as well as international cooperation and exchange in developing maglev technology. Many top international maglev experts participated in extensive and in-depth discussions on innovations in maglev technology and the development and challenge of maglev transportation. Members of CNERC-Rail (HK Branch) attended the conference and gave a presentation entitled “Experimental Study on Dynamic Performance of Medium and Low Speed Maglev Train Running on the Turnout”, and received the excellent presentation award (Fig. 3.17).

Fig. 3. 17 Excellent Presentation Award of the 25th International Conference on Magnetically Levitated System and Linear Drives (Maglev 2022)

3.2.13 2022 Asian Conference on Frontiers of Power and Energy (ACFPE 2022)

ACFPE 2022 was held in Chengdu, China from October 21 to 23, 2022. The event was co-organized by Sichuan University and Hong Kong Society of Mechanical Engineers (HKSME), and technically sponsored by IEEE PES Chongqing Chapter, Shanghai Jiao Tong University and University of Electronic Science and Technology of China. ACFPE 2022 aimed at bringing together participants from academic, industrial, engineering, and administrative organizations around the world to exchange novel ideas, discuss innovative designs, explore enabling technologies to tackle problems, and share field trial experiences in power and energy areas. ACFPE has been an active platform which facilitate participants to establish business relationships and to find partners for future collaboration in their fields.

Professor Ka-Wai Cheng, a key-member of CNERC-Rail (HK Branch), was invited to give a keynote speech “Energy Storage Management: Present and Future” (Fig. 3.18).

Fig. 3. 18 Keynote speech "Model-driven Quantitative Nonlinear Ultrasonics" by Prof. Zhong-Qing Su

3.2.14 The 7th International Conference on New Energy and Future Energy Systems, (NEFES 2022)

NEFES 2022 was held between October 25 to 28, 2022 in Nanjing, China with a option of attendance online. It was co-hosted by School of Mechanical Engineering, Southeast University. This annual conference provides a platform for researchers, scientists, engineers and professionals from all over the world to present their latest research result and new ideas in terms of new energy and future energy system. NEFES 2022 program included keynote speeches, invited speeches, oral presentations as well as poster presentations and post-conference technical investigation.

Professor Ka-Wai Cheng, a key-member of the centre, was invited to give a plenary speech entitled "Topology and Formation of Current Source Step Down Resonant Switched Inductor Converters" (Fig. 3.19).

Fig. 3. 19 Plenary speech "Topology and Formation of Current Source Step Down Resonant Switched Inductor Converters" on NEFES 2022

3.2.15 2022 IEEE Transportation Electrification Conference and Expo, Asia-Pacific (ITEC Asia-Pacific 2022)

2022 IEEE Transportation Electrification Conference and Expo, Asia-Pacific (ITEC Asia-Pacific 2022) was held in the Zhejiang University International Campus, Haining, Zhejiang Province, China on October 28 to 31, 2022. ITEC Asia-Pacific was part of the global IEEE ITEC conference series (Fig. 3.20). It aimed to provide a forum for sharing knowledge, experience, and ideas in electrical technologies for transportation. The conference covered many major topics in power electronics, electric machines, and power systems for transportation electrification.

A key member of CNERC-Rail (HK Branch), Prof. Kang-Kuen LEE, gave a tutorialon "Use of FBG sensors for the fully automated condition monitoring of the health of tracks and running gear of trains based on a case study of the Train Track Condition Monitoring system currently operating in SMRT, Singapore".

Fig. 3.20 ITEC Asia-Pacific 2022

3.2.16 Symposium on Implementing the Innovation and Technology Policy of the Hong Kong Chief Executive's 2022 Policy Address

On November 1, 2022, Dr. You-Wu Wang, Dr Wai-Kei Ao and Dr Zheng-Wei Chen (Research Assistant Professors of CNERC-Rail (HK Branch)) attended the Symposium on Implementing the Innovation and Technology Policy of the Hong Kong Chief Executive's 2022 Policy Address. On behalf of Prof. Yi-Qing Ni (Director of CNERC-Rail (HK Branch)), Dr. You-Wu Wang, Dr Wai-Kei Ao and Dr Zheng-Wei Chen introduced research profiles of CNERC-Rail (HK Branch) to Prof. Dong Sun (Secretary for Innovation, Technology and Industry of Hong Kong, SAR Government). Prof. Dong Sun expressed his appreciation of the support of Prof. Yi-Qing Ni and the research team of CNERC-Rail (HK Branch).

Fig. 3.21 The participation of center members in the Symposium on Implementing the Innovation and Technology Policy of the Hong Kong Chief Executive's 2022 Policy Address

3.2.17 Global Meet on Electronics and Electrical Engineering (GMEEE2022)

GMEEE2022 held in Barcelona, Spain during November 3 to 5, 2022. GMEEE2022, was an annual meeting which provided a platform for researchers, engineers, academicians and industrial experts from all over the world to present their research results and professional development activities in Electronics and Electrical Engineering. The meeting brought together world class experts and young researchers who took opportunities for exchanges crossing the traditional discipline boundaries which allowed them to explore multidisciplinary challenging problems.

Professor Ka-Wai Cheng, a key-member of CNERC-Rail (HK Branch), was invited to give a keynote speech entitled "Challenges and Recent Development for Electric Vehicles and Energy Storage".

Fig. 3.22 Keynote speech "Challenges and Recent Development for Electric Vehicles and Energy Storage" on GMEEE2022

3.2.18 The 12th IET International Conference on Advances in Power System Control, Operation and Management (APSCOM)

The challenges and opportunities of the power industry changed rapidly in recent years due to transformational technological advancement in different sectors such as artificial intelligence, Internet of things and Green energy. IET Hong Kong has been taking an active role in leading the industry in confronting these challenges. Since the inception of the event in 1990, APSCOM has been the flagship event of IET Hong Kong serving as a forum for professionals and specialists to share ideas, knowledge and experiences on promoting the high performance & resilience of power grid. The 12th IET International Conference on Advances in Power System Control, Operation and Management (APSCOM) was held during November 7-9, 2022 at Hyatt Regency Hotel, Tsim Sha Tsui, Hong Kong.

Professor Ka-Wai Cheng, a key-member of CNERC-Rail (HK Branch), was invited to give a keynote speech on “Energy Storage Power Conversion and Future Fuel For Electric Vehicles”.

Fig. 3.23 Keynote speech on “Energy Storage Power Conversion and Future Fuel For Electric Vehicles” on APSCOM

3.2.19 The 9th Asia-Pacific Workshop on Structural Health Monitoring (APWSHM 2022)

APWSHM 2022 was held during December 7-9, 2022 in Cairns Australia. This was the ninth biennial workshop focusing on the science and application of Structural Health Monitoring. The purpose of this workshop was to provide a forum for the dissemination of new principles, technologies, and applications in SHM; for the discussion of emerging issues and opportunities; and for promoting information exchange and cross-fertilisation within this highly multidisciplinary field.

A key member of CNERC-Rail (HK Branch), Prof. Zhong-Qing Su, gave a keynote speech on “Model-driven Quantitative Nonlinear Ultrasonics” in the Plenary Talk.

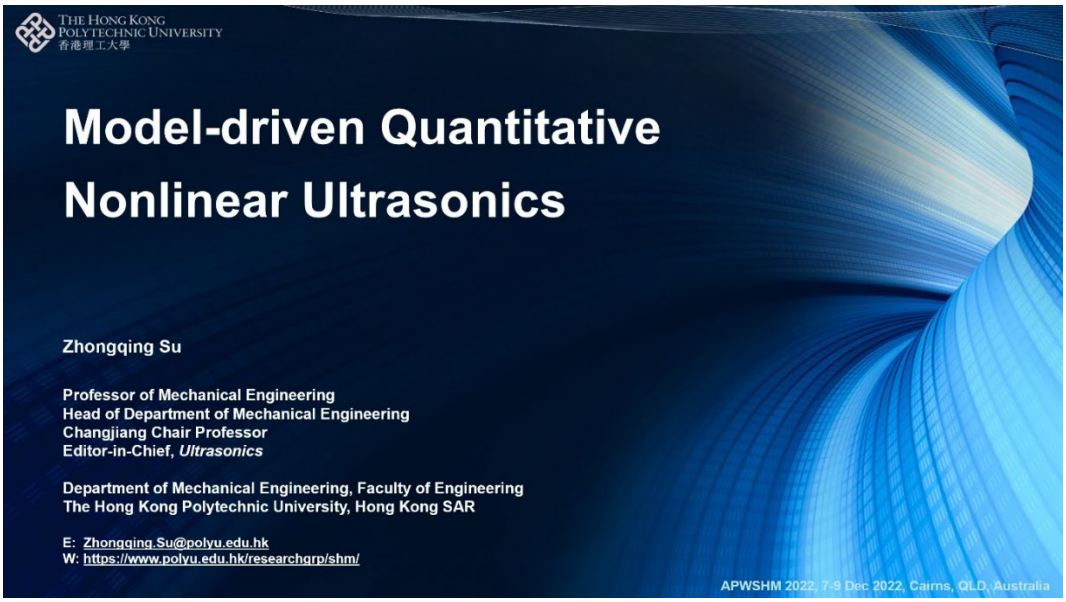


Fig. 3.24 Keynote speech “Model-driven Quantitative Nonlinear Ultrasonics” by Prof. Zhong-Qing Su

3.3 Cross Institutes Technical Exchanges

3.3.1 Technical Exchange with Staff of MTR Corp Ltd

On March 23, 2022, and April 13, 2022, members of the research center visited the freight section near MTR Lo Wu Station twice for site inspections and to communicate with MTR Corp Ltd on the site sensor arrangement plan. Based on the findings, the two parties jointly determined the basic plan for site monitoring and sensor installation (Fig. 3.25).

Fig. 3. 25 On-site research and technical communication at Lo Wu Station

3.3.2 Journal of Transportation Safety and Environment

On June 30, 2022, an online conference on “Train Safety in Complex Environment” organised by the editorial board of Transportation Safety and Environment was held, and was simulcast through China Knowledge and Bilibili. Dr. Zheng-Wei Chen, a member of CNERC-Rail (HK Branch), gave a presentation on the topic of “Mechanisms of high-speed train aerodynamic performance degradation and optimization under sudden change of windbreak wall boundary” (Fig. 3.26). Under the wind environment, sudden change in boundary of windbreak walls weakened their protection effect in high speed railway, resulting in reduction of train running safety. Windbreak wall modifications developed in this study, significantly enhance train operating speed limit.

Fig. 3. 26 Online Presentation by Dr. cheng in conference organised by Traffic Safety and Environment editorial office.

3.3.3 Department of Mechanical Engineering of PolyU

On November 2, 2022, Dr. Zheng-Wei Chen, Dr. E Deng and research assistants Zhan-Hao Guo and Guang-Zhi Zeng visited the Department of Mechanical Engineering of PolyU. During the visit, Dr. Fu-Wang Zhao from Associate Professor Hui Tang's team introduced their research related to flow control and drag reduction with tests in wind tunnel while Dr. Zheng-Wei Chen introduced research under CNERC-Rail (HK Branch) (Fig. 3.27). They then discussed in depth about the subsequent use of wind tunnel facilities for train aerodynamics experiments, and the two sides finally agreed an intention of cooperation.

Fig. 3. 27 Wind tunnel laboratory in Department of Mechanical Engineering of PolyU

3.3.4 Harbin Institute of Technology (Shenzhen)

On November 26, 2022, Dr. Zheng-Wei Chen, Dr. E Deng and research assistants Zhan-Hao Guo and Guang-Zhi Zeng conducted an online technical meeting with Professor Gang Hu of Harbin Institute of Technology (Shenzhen) on fluid mechanics, wind engineering, and applications of machine learning in computational fluid dynamics (Fig. 3.28). Dr. Zheng-Wei Chen and Dr. E Deng first gave an overview of research in CNERC-Rail (HK Branch), and then focused on the research on train aerodynamics and computational fluid dynamics applications. Prof. Gang Hu then introduced research results of his team in wind engineering

and machine learning applications. Both parties agreed to exchange regularly technical information to foster their respective academic capability.

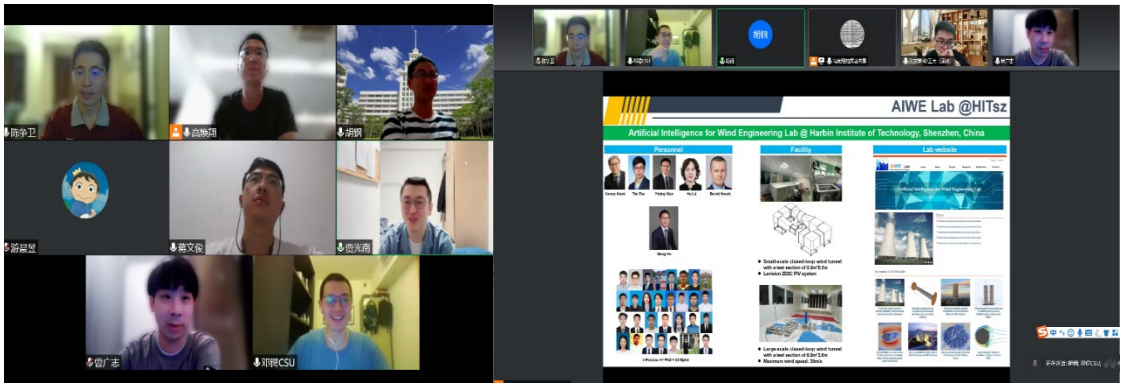


Fig. 3. 28 Online with Professor Gang Hu from Harbin Institute of Technology (Shenzhen)

3.3.5 Department of Aviation and Civil Aviation Engineering, Hong Kong Polytechnic University

On December 13, 2022, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), and Prof. Chih-Yung Wen, Head of the Department of Aviation and Civil Aviation Engineering of the Hong Kong Polytechnic University, together with their team members held an online meeting (Fig. 3.29). The two sides introduced major scientific and technological achievements in their respective research fields, and conducted in-depth discussions and communication on subjects of urban aerodynamics, underwater unmanned robots and others. Some feasible suggestions were put forward for the development of coupling solver of high-fidelity computational fluid dynamics (CFD) and machine learning (ML) for large-scale urban wind environment. Finally, Prof. Yi-Qing Ni enguired the use of unmanned system developed by Prof. Wen's team for monitoring of underwater structures such as bridge piers. Prof. Wen warmly invited CNERC-Rail (HK Branch) members to visit his laboratory.

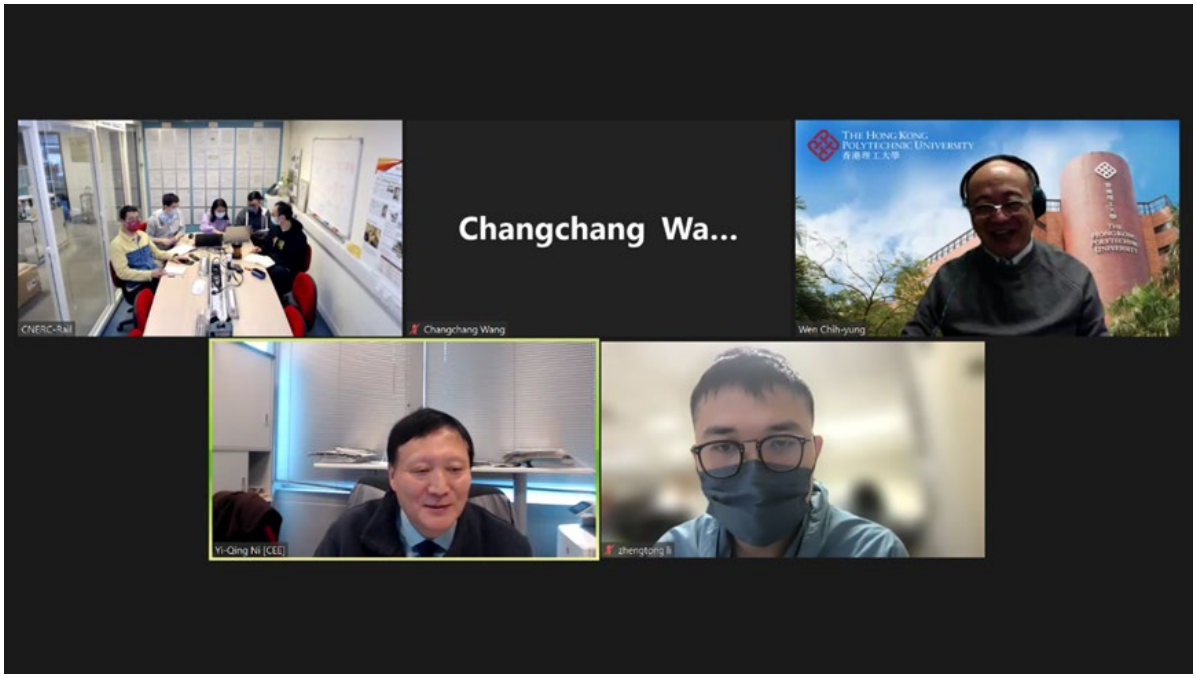


Fig. 3. 29 Online meeting between Prof. Yi-Qing Ni and Prof. Chih-Yung Wen

3.3.6 Professor Tao Yu, Department of Civil and Environmental Engineering of the Hong Kong Polytechnic University

On December 23, 2022, Prof. Yi-Qing Ni, Director of CNERC-Rail (HK Branch), and Prof. Tao Yu, together with their team members held an online meeting (Fig. 3.30). Mr. Xiang-Xiong Li introduced the implementation of the test project at Zhuzhou, including sensor installation and data analysis. Mr. Zhen Lin then introduced the development of fluorescent sensor and its use for monitoring chloride ion, sulfate ion and PH value, as well as, system design. Dr. Yu Xiang, a member of Prof. Tao Yu's team, presented the testing and application of seven sensors, including fiber optic humidity sensor, fiber optic pH sensor, chloride and sulfate sensor, integrated fiber optic sensor system for micro-environment monitoring, wireless sensor, hybrid sensor network, and optimized hybrid sensor network. Dr. Xiang also introduced some actual projects where sensors could be installed and the construction timeline. Finally, Prof. Tao Yu suggested personnel from both teams continued to discuss the subject in detail after the meeting.

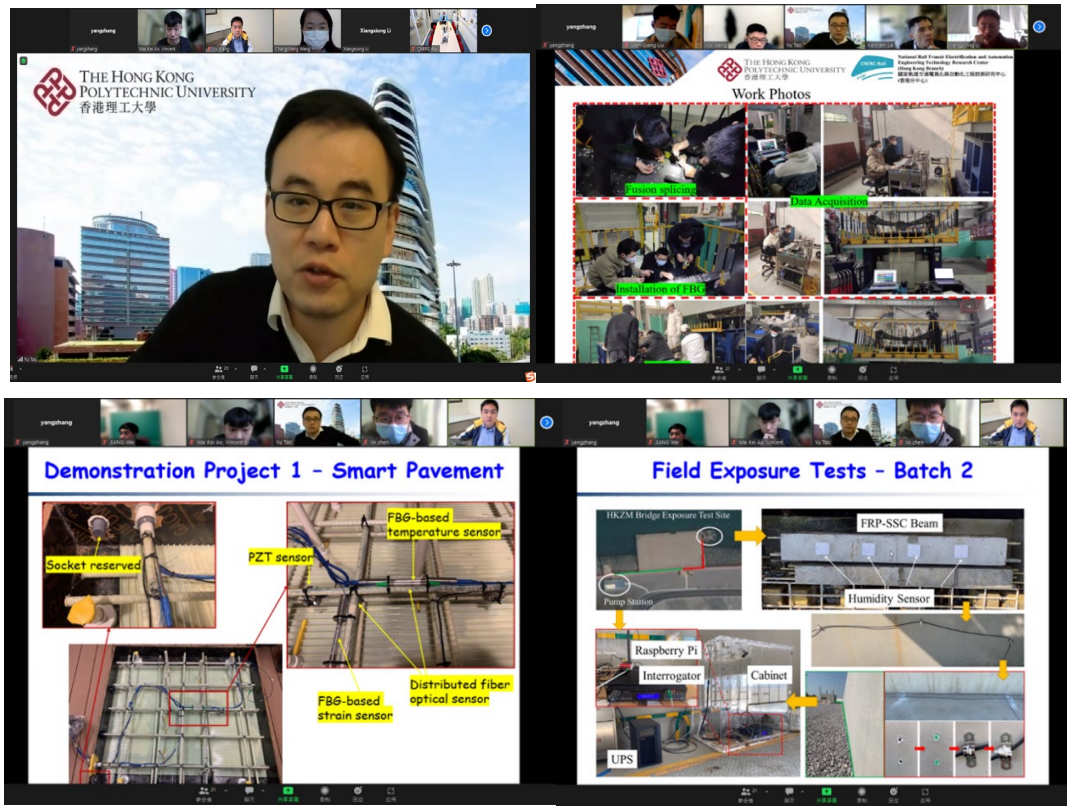


Fig. 3. 30 Online meeting between Prof. Yi-Qing Ni and Prof. Tao Yu

3.3.7 Technical Exchange Activities with the Appointed Contractors of MTR Corp Ltd

On December 28, 2022, Dr. Chun-Xiang Lai, Mr. Qi-Fan Zhou and Mr. Da-Zhi Dang, members of CNERC-Rail (HK Branch), exchanged with MTR Corp Ltd appointed contractors about the materials used in the route, installation process and construction safety (Fig. 3.31). The proposed drawings have been submitted to MTR Corp Ltd for approval. During the review period, Mr. Qi-Fan Zhou and Mr. Da-Zhi Dang will visit the Lo Wu Station to measure the site dimensions and put the planning scheme into practice.

Fig. 3. 31 Technical exchanges with the appointed contractor of MTR Corp Ltd

3.4 Organized Seminars

3.4.1 Head of Department of mechanical Engineering Professor Su Zhongqing Lecture Series

（1）Lecture in Hangzhou Laboratory, Zhejiang Province

On November 23, 2022, a key member of CNERC-Rail (HK Branch), Professor Zhong-Qing Su, Head of Department of Mechanical Engineering PolyU, gave an online for the "Hangzhou Laboratory, Zhejiang Province" on the topic "Totally-additive-manufacturing-driven Sensing Technology" (Fig. 3.32). More than 500 people attended the lecture online and offline.

Fig. 3.32 Online lecture by prof. Su for Hangzhou Laboratory, Zhejiang Province

（2）Online lecture for Xiamen University

On July 25, 2022, Professor Zhong-Qing Su, Head of Department of Mechanical Engineering PolyU, gave an online lecture entitled "Totally-additive-manufacturing-driven Sensing Technology" for summer college of Xiamen University (Fig. 3.33). More than 450 people attended the lecture online and offline.

Fig. 3.33 Online lecture by prof. Su for Xiamen University

（3）Sharing in Beihang distinguished seminar series

On September 21, 2022, Professor Zhong-Qing Su, Head of Department of Mechanical Engineering, made a presentation online research in the "Beihang distinguished seminar series" introducing "Recent advances in quantitative nonlinear ultrasonics: from analytical modelling to engineering applications". On November 23, 2022, Professor Zhong-Qing Su, shares online his research in the "Beihang distinguished seminar series" on the subject "Totally-additive-manufacturing-driven Sensing Technology" (Fig. 3.34). More than 400 people in each seminar online and offline.

Fig. 3.34 Presentations by Prof. Su in Beihang distinguished seminar series

3.4.2 FCE Chair Professor Lecture Series

On July 26, 2022, Professor Yi-Qing Ni, Director of CNERC-Rail (HK Branch), gave an online presentation on technology for "Online Monitoring and vibration/Noise Control of Railway Systems: from Metro to Maglev" at the Hong Kong Polytechnic University (Fig. 3.35). He outlined the development and application of sensor systems in online and rolling

monitoring of subway, intercity/intercity railway, high-speed railway and maglev trains, as well as the development and application of intelligent damping technology for vibration and noise control in railway systems. More than 400 people participated in the event online and offline.

Fig. 3.35 Presentations by Prof. Ni in FCE Chair Professor Lecture series

3.4.3 The Second "Intelligent Transportation Infrastructure" International Young Scholars Forum

On October 20, 2022, Associate Professor Siu-Kai Lai, Member of CNERC-Rail (HK Branch) gave a presentation at the 2nd International Forum for Young Scholars on Intelligent Transport Infrastructure entitled "A World of Lot Opportunity for Smart Railway Development: Toward a Self-powered Real-time Monitoring System" (Fig. 3.36). His presentation introduced the design concepts of multi-stable, wideband and tri-hybrid energy harvesting technologies that can work well in dynamic coupling with trains at low frequency, low amplitude and time-varying environmental sources. With the support of this self-powered system, wireless sensors can be deployed on running trains (within the axle box/bogie frame) to directly measure vibration, stress and noise data. The innovative system can fill the technology gap in vehicle

control and monitoring system of existing trains enabling further improvement in railway operation safety.

Fig. 3.36 Online presentation by Dr. Siu-Kai Lai at second "Intelligent Transportation Infrastructure" International Young Scholars Forum

3.4.4 Online Lecture for Dalian Maritime University

On November 10, 2022, Professor Yi-Qing Ni, Director of CNERC-Rail (HK Branch), gave an online lecture about "The Impact of Machine Learning Based on Physical Information on the Research of Mechanics and Structural Engineering" for Dalian Maritime University (Fig. 3.37). More than 350 people attended the lecture online and offline.

Fig. 3.37 Online lecture by Professor Ni Yiqing for Dalian Maritime University

3.4.5 CNERC-Rail (HK Branch) Seminar Series

On December 9, 2022, Professor Costas Papadimitriou from the University of Thessaly shared his research outcomes online in CNERC-Rail (HK Branch) seminar series. His presentation was entitled "Hierarchical Bayesian Modeling of Uncertainty Quantification and Propagation in Structural Dynamics Simulations" (Fig. 3.38). Prof. Papadimitriou introduced

the latest development of hierarchical Bayesian modeling (HBM) framework based on data-driven uncertainty quantification and engineering simulation propagation. The effectiveness of the proposed HBM framework was verified through simulation and experimental studies of structural dynamics.

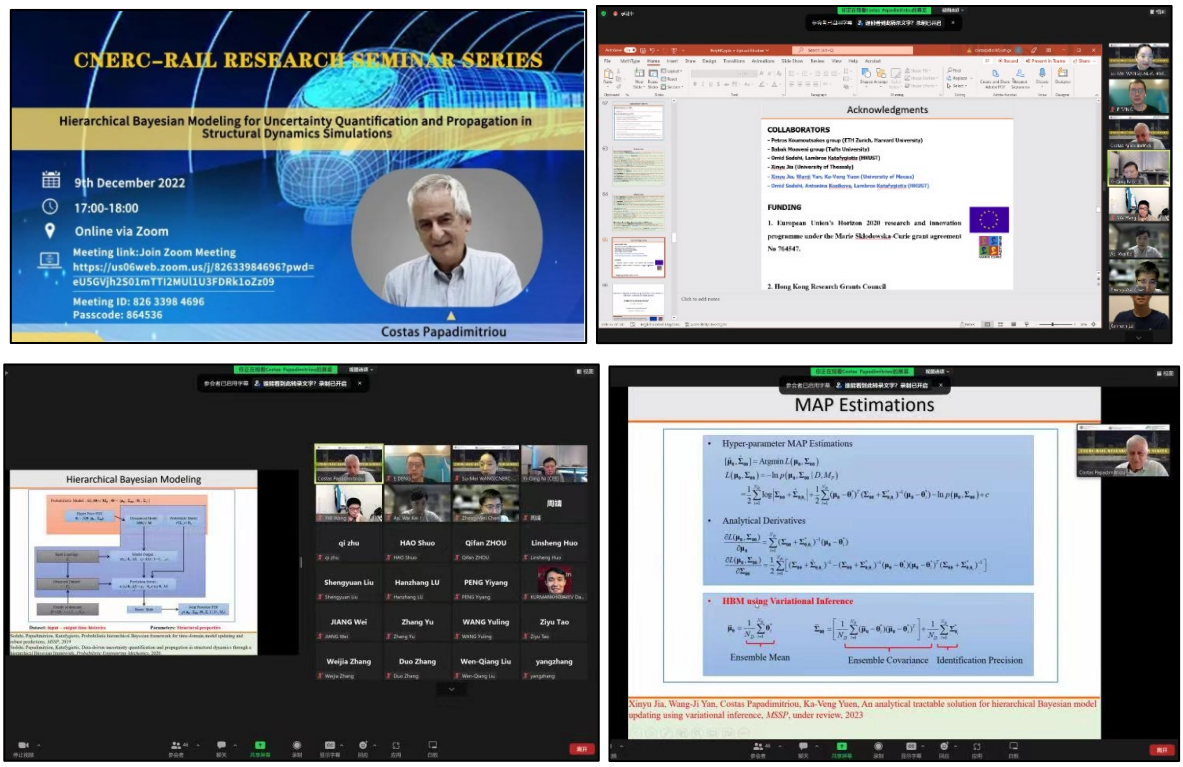


Fig. 3.38 CNERC-Rail (HK Branch) Seminar series-presentation by Prof. Papadimitriou

3.4.6 Optical Communications and Sensing for Next-generation Green and Smart Systems International Symposium

In several areas, photonics has been providing new solutions to key issues. For instance, the majority of data traffic on the planet is carried by means of transmission through optical fiber network, which serves as the backbone of the current communication infrastructure. On the other hand, at optical fiber-based sensors have enabled remarkable advancement in sensing application in various fields including physical, chemical, biological, environment, etc. These two niche features of optical fibers would be crucial in developing future green and intelligent optical technologies, making optical fiber an essential element of the internet of everything (IoE). This symposium brought will bring together professionals in the field of photonics to share recent advancements in optical fiber field applications.

On November 21, 2022, Professor Hwa-Yaw Tam, a key-member of the CNERC-Rail (HK Branch), gave a presentation organized by King's Fahd University of Saudi Arabia in

partnership with IEEE, entitled "From an accidental discovery to AI-enabled photonic sensor networks" at the symposium. (Fig. 3.39)

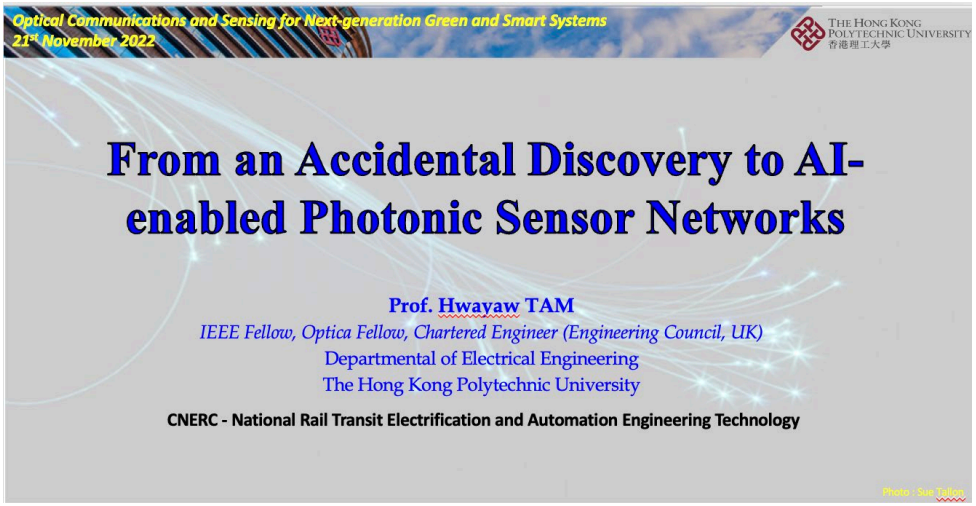


Fig. 3.39 Presentation by Prof. Tam at International Symposium on Optical Communications and Sensing for Next-generation Green and Smart Systems

3.4.7 Online Lecture for Jiangsu University

On December 12, 2022, Professor Yi-Qing Ni, Director of CNERC-Rail (HK Branch), gave an online lecture entitled "Online Monitoring, Intelligent Operation and Maintenance of rail Transit and Vibration/Noise Control" for Jiangsu University ((Fig. 3.40). The lecture mainly introduced the application of structural health monitoring system in subway, high-speed rail and maglev trains, the application of vibration control and sound control technologies in railway field; the application of energy harvesting device in railway system, and the application of big data and deep learning algorithm in railway system.

Fig. 3.40 Online lecture by Professor Yi-Qing Ni, for Jiangsu University

3.4.8 CNERC-Rail (HK Branch) Seminar Series

Dr. Xin-Xing Yuan, a structural engineer in Albuquerque, New Mexico, USA, was invited to give an online presentation on December 16, 2022 in CNERC-Rail (HK Branch) seminar series. The subject of her presentation was “Bridge Construction Monitoring using Lidar for Quantitative, Objective Quality Control”. An abstract of Dr. Yuan’s presentation is given in Fig.3.41.

Fig. 3.41 CNERC-Rail (HK Branch) seminar series-Presentation by Dr. Yuan

3.5 Visiting Scholars & Delegations

3.5.1 Delegation from Hong Kong Institution of Engineers (HKIE)

On June 25, 2022, more than 20 members of the Environment at Division of the Hong Kong Institution of Engineers (HKIE) visited CNERC-Rail (HK Branch) and the research facilities in the Industrial Center (Fig. 3.42). Dr. Su-Mei Wang, Research Assistant Professor, and other members of CNERC-Rail (HK Branch) received the delegation. They introduced the latest R&D technology and facilities of the CNERC-Rail (HK Branch) to the guests.

Fig. 3.42 Delegation from Hong Kong Institution of Engineers (HKIE)

3.5.2 Delegation from Zhejiang Provincial Transportation Investment Group Co., Ltd

On August 12, 2022, Mr. De-Hua Wang, Chief Representative and General Manager of Zhejiang Transportation Investment Group Co., Ltd., led a delegation to visit CNERC-Rail

(HK Branch) and the research facilities in the Industrial Center (Fig. 3.43). Mr. Wang and his colleagues were warmly received by Dr. You-Wu Wang, Research Assistant Professor, at the CNERC-Rail (HK Branch). Dr. Wang introduced the main research areas and the latest achievements of the CNERC-Rail (HK Branch) to the visitors.

Fig. 3.43 Delegation from Zhejiang Provincial Transportation Investment Group Co., Ltd

3.5.3 Members of the Council of Hong Kong Polytechnic University

On August 16, 2022, three new directors of the Hong Kong Polytechnic University, Mr. Fu-An Zhou, Mr. Rayman Chui Man-Wai and Mr. Guo-Hui You, visited CNERC-Rail (HK Branch) (Fig. 3.44). Two Research Assistant Professors Dr. Chun-Xiang Lai, and Dr. Wei-Ji Ou and Research Technical Assistant Mr. Da-Tong Wei, introduced the research facilities of the Center to the three gentlemen.

Fig. 3.44 Members of the Council of Hong Kong Polytechnic University accompanied by CNERC-Rail (HK Branch) staff

3.5.4 Delegation from China Development Bank Hong Kong Branch

On August 26, 2022, Mr. Xi-Guang Li, CEO of China Development Bank Hong Kong Branch, led a delegation to visit the Railway Engineering Laboratory in the Polytechnic University's Industrial Center (Fig. 3.45). Mr. Li and other senior personnel were warmly received by Professor Qing-Yan Chen, Dean of PolyU Academy for Interdisciplinary Research (PAIR) of the Hong Kong Polytechnic University, Dr. Wei-Ji Ou, Assistant Professor of the Research Center, and Mr. Wei Zhao, Assistant Director of the Office of Research and Innovation. Research teams of CNERC-Rail (HK Branch) introduced the major research directions and achievements of the Center to the guests.

Fig. 3.45 Delegation from China Development Bank Hong Kong Branch and senior personnel of Hong Kong Polytechnic University

3.5.5 Delegation from China Merchants Group

On September 6, 2022, Mr. Ren-Jie Deng, Executive Deputy General Manager of China Merchants Group (CMG), led a delegation to visit CNERC-Rail (HK Branch) and the research laboratory of the Center (Fig. 3.46). Mr. Ren-Jie Deng and his colleagues were warmly received by Dr. You-Wu Wang, Research Assistant Professor and Mr. Da-Tong Wei, Research Technical Assistant of CNERC-Rail (HK Branch), who introduced the Centre's facilities, major research projects undertaken and the latest technologies developed to the visitors.

Fig. 3.46 Delegation from China Merchants Group

3.5.6 Delegation from China State Construction (Hong Kong) Co., Ltd

On October 10, 2022, Mr. Jiang Huang, Executive Deputy General Manager of China State Construction (Hong Kong) Co., Ltd., and Mr. Ming Zhang, Deputy General Manager and Chairman of Civil Engineering Foundation, visited the Railway Engineering Laboratory in the company of Professor Pei Zhao, Deputy Director of the Scientific Research and Innovation Division of the Hong Kong Polytechnic University (Fig. 3.47). Dr. Zheng-Wei Chen, Research Assistant Professor of CNERC-Rail (HK Branch), and Mr. Da-Tong Wei, Research Technical Assistant, warmly received the delegation. Dr. Chen and Mr. Wei briefed the visitors the research directions and achievements of the Center.

Fig. 3.47 Delegation from China State Construction (Hong Kong) Co., Ltd

3.5.7 Hangzhou Shenhao Technology Co., Ltd

On October 28, 2022, Mr. Jun-Jie Xiong, Deputy General Manager and Assistant Chairman of Hangzhou Shenhao Technology Co., Ltd. visited the research laboratory of CNERC-Rail (HK Branch) (Fig. 3.48). Mr. Xiong was warmly received by Professor Yi-Qing

Ni, Director of CNERC-Rail (HK Branch). Scholars of the Centre including Assistant Professor You-Wu Wang, Mr. Zhen Lin, Mr. Bo-Yang Su, Dr. Wen-Qiang Liu, Mr. Da-Zhi Dang, Mr. Yang Lu and Ms. Jia-Mei Wang were present welcoming Mr. Xiong. Professor Yi-Qing Ni introduced the Centre's research directions and had fruitful discussions with Mr. Xiong about in-depth collaboration in research development and applications of railway technologies.

Fig. 3.48 Mr. Xiong from Hangzhou Shenhao Technology Co., Ltd and staff of CNERC-Rail

3.5.8 Mr. Zheng-An Xu, Former General Manager and Chief Engineer of Anhui Architectural Design and Research Institute Co., Ltd

On November 11, 2022, Mr. Zheng-An Xu, former General Manager and Chief Engineer of Anhui Architectural Design and Research Institute Co., Ltd., visited CNERC-Rail (HK Branch) and the research laboratory of CNERC-Rail (HK Branch) (Fig. 3.49). Mr. Xu was warmly received by Professor Yi-Qing Ni, Director of CNERC-Rail (HK Branch). Some members of the Center including Research Assistant Professor Dr. Da-Zhi Dang, Dr. You-Wu Wang, Dr. Bo-Yang Su and Research Technical Assistant Mr. Da-Tong Wei were present to welcome Mr. Xu.

Fig. 3.49 Mr. Zheng-An Xu and staff of CNERC-Rail (HK Branch)

3.6 Media Interview

3.6.1 TVB Interview with Radio Television Hong Kong (Highlights of Railway Monitoring Technology)

Prof. Hwa-Yaw Tam, a key-member of CNERC-Rail(HK Branch), was interviewed by TVB in early 2022 for a TV program on the applications of optical fibre sensor technologies. Prof. Tam explained the use of optical fibre sensor technologies. The episode was broadcasted on March 2, 9:30pm on TVB 85 Channel programme. The episode was also uploaded to TVB website, and YouTube channel.

Figure 3.50 Professor Hwa-Yaw Tam was featured in an episode of a TVB programme series

3.6.2 TVB Interview

In September 2022, Dr. Su-Mei Wang, Research Assistant Professor of CNERC-Rail(HK Branch), was interviewed by the Hong Kong TVB for a special program "Decoding the Greater Bay Area: Maglev Train". To promote the development of the Guangdong-Hong Kong-Macao Greater Bay Area, the mainland is studying the construction of high-speed maglev, including Hong Kong Station and Nansha Station in the initial plan. In this connection, Dr. Wang introduced research carried out by CNERC-Rail(HK Branch) in the field of maglev monitoring and control in the interview video, and shed light on the operation of maglev in the Greater Bay Area including key technology of maglev trains, project cost and maintenance.

Fig. 3.51 Dr. Su-Mei Wang, research assistant professor of CNERC-Rail (HK Branch), speaking in front of camera

3.6.3 Hong Kong TV Show “Hong Kong Story: Hong Kong Inventors”

On December 19, 2022, Prof Eric Ka-Wai Cheng, Director of PERC, shared his devotion to building his dream car in a RTHK TV programme series “Hong Kong Stories: inventors in Hong Kong”. (Fig. 3.52). Professor Ka-Wai Cheng, Department of Electrical Engineering, Hong Kong Polytechnic University, known as "the father of Hong Kong electric vehicles" has led the team to develop all-electric vehicles as early as 2005, making Hong Kong one of the world's first places to develop electric vehicle technology. Professor Ka-Wai Cheng likes to

disassemble and reorganize the home objects from childhood, and aims to become an engineer. He believes that turning interest into work is a joy of life.

Fig. 3.52 Professor Ka-Wai Cheng, Director of PERC, appearing on RTHK programme

3.7 Five-year Review by the Ministry of Science and Technology

On November 9, 2022, CNERC-Rail (HK Branch) research team attended an online interview to report the five-year periodic review of the center's operation to China Science and Technology Exchange Center, Hong Kong Innovation and Technology Commission, Department of Research Commercialization and Regional Innovation of Ministry of Science and Technology, Hong Kong, Macao and Taiwan Affairs Office of Ministry of Science and Technology and other parties. Professor Yi-Qing Ni, director of CNERC-Rail (HK Branch), first introduced the basic information, research direction, personnel training, engineering facilities and equipment of CNERC-Rail (HK Branch) to the defense committee. After that, detailed reports were made on engineering research and development projects and applications, award-winning achievements, intellectual property rights, open exchanges and services, center construction management and operation, and development plans and objectives (Fig. 3.53). The vast and fruitful outcomes of CNERC-Rail (HK Branch) were unanimously accredited by the panel members of China Science and Technology Exchange Center and other organizational departments.

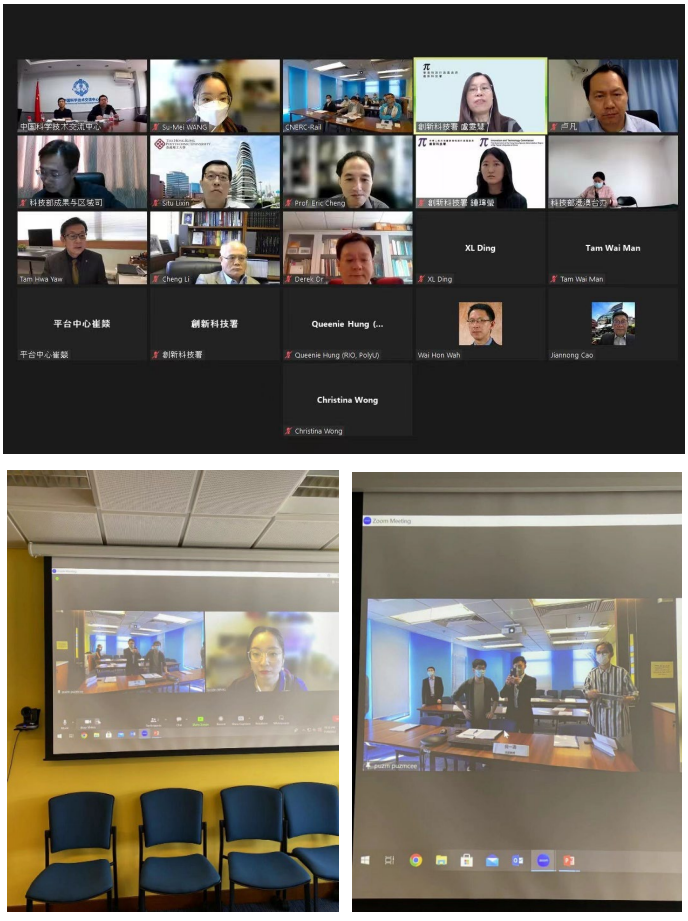


Fig. 3.53 Five-year Evaluation of CNERC-Rail (HK Branch) by Ministry of Science and Technology

Appendix

A.1 Equipment Purchased

A.2 News Reports

Appendix

A.1 Equipment Purchased

No.	Device/Sensor	Number
1	Fusion Splicer for Connect Fibre Optic Cable	1
2	ODiSI6100 Interrogator	1
3	High Speed Camera	1
4	CFG Sensors	8
5	DEWESOFT DS-Tachometer	2
6	A Research-grade Wearable Sensor Built for Ultimate Control	5
7	Dual-channels Signal Generator and Strain Module	1
8	Camera System for Displacement Tracking-main System	1
9	Electromagntic Shaker / Power Amplifer	1
10	Hyperspectral Camera	1
11	Prepolarized Free-field Microphone	10
12	Long Distance DAQ over 1 km	1
13	Advance Vibration Control System dSpace	1
14	DAQs for Pressure Sensors	4
15	Pressure Sensor	50
16	High Speed Fibre Optical Interrogator	2
17	Railway Corrugation Analysis Trolley	1
18	Maglev Sensor	2
19	Ultrasonic Wind Sensor	4
20	Railway Finite Element Model Simulation Software	1
21	MATLAB Software	1
22	Fusion Splicer for Optical Fibre	3
23	Spectrometer	1

24	Optical Acquisition System	1
25	Machine Vision System for Speed Measurement	1
26	Dytran Impact Hammer	3
27	Optical Fibre Accelerometer	30
28	3D Maglev Railway AI Inspection System	1
29	Laser Displacement Sensor	4
30	DJI Software	1
31	Mixed Reality Glass	1
32	Lidar Laser Radar	1
33	Master & Slave Workstations	1
34	NVIDIA Edge AI Developer Kit: Jetson AGX Orin Developer Kit	1
35	VIS Spectrometer	1

A.2 News Reports

youtube.com/watch?v=8JED-AmdR10

YouTube HK 搜索

TVB 創科導航 - 一條光纖的誕生 / 運動型電競（簡/繁字幕）

無綫新聞 TVB NEWS official 20.1万位订阅者 订阅

12 分享 下載 剪辑 保存

1804次观看 9个月前 #無綫新聞 #大學 #香港新聞
創科導航 - 一條光纖的誕生 / 運動型電競

有大學研發了一種可用在醫療方面的塑料光纖傳感器，令醫生更容易監測和進行手術。本地有電競館將運動跟電競融合，為了令運動場景的像真度更高，團隊在遊戲模擬器及軟件兩方面做了多少工 展开

創科導航

主頁 每集內容

« 返回所有集數 第268/308集

2022.03.02 - 一條光纖的誕生 / 運動型電競

播出日期: 2022.03.02 (三) ▶播放

有大學研發了一種可用在醫療方面的塑料光纖傳感器，令醫生更容易監測和進行手術。本地有電競館將運動跟電競融合，為了令運動場景的像真度更高，團隊在遊戲模擬器及軟件兩方面做了多少工夫？

« 返回所有集數 第268/308集

RTHK·HK TV RADIO NEWS WEB+ ARCHIVE APPS OURTHK 繁 / 簡

RTHK 31 LIVE

All Episodes

創科新里程

遊走千里之間

02/04/2022

內容 CONTENT

02/04/2022 Photo Album

隨著大灣區的掘起，高鐵網絡的發展變得十分重要。香港理工大學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與內地及新加坡的鐵路公司合作研究發進行測試，測試項目圍繞鐵路安全、智能系統、供電系統、電磁波及新物料等，務求精益求精，改良鐵路系統從而加強城市的競爭力。近年團隊正在與國內多家鐵路公司合作，完善未來國內及大灣區的磁浮列車網絡。

受訪嘉賓:倪一清教授(理工大學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)

Tag: 國家軌道,交通電氣化,自動化工程技術研究中心,理工大學,電磁波,供電系統,倪一清教授,智能系統,鐵路,鐵路安全

RTHK31 電視直播

所有集數

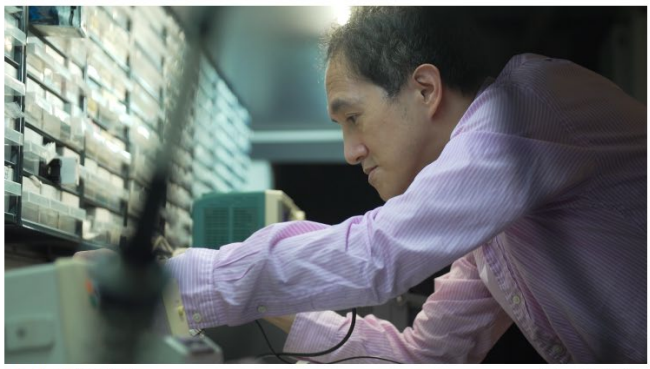
香港故事:創科夢工場

人車誌:鄭家偉

19/12/2022

內容 CONTENT

監製：監製:張詠賢



19/12/2022 相片集

人車誌:鄭家偉

香港理工大學電機工程學系教授鄭家偉，有「港產電動車之父」之稱，早於2005年已帶領團隊研發全電動車，令香港成為全球最早研發電動車技術的地方之一。鄭家偉教授從小便喜歡將家中物件拆開重組，並以成為工程師為人生目標，認為將興趣變成工作是人生樂事。

鄭家偉幻想有一天，電動車能像電影變形金剛「Transformer」的機械人般，令車身可以隨意延長或擴闊，甚至兩架車可以二合為一，多年來他一直研究有關技術，一步一步向夢想邁進……

Tag: 鄭家偉,電動車,理工大學,poly U,Cheng Ka Wai

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深圳市住房和建设局关于《深圳市建设工程新技术推广目录（2022年）》的公示

信息来源：深圳市住房和建设局　信息提供日期：2022-12-06 16:43　【字体：大 中 小 】　视力保护色：

各有关单位：

为贯彻实施创新驱动发展战略，促进本市住房和建设领域科技成果转化推广，推动行业技术进步和高质量发展，深圳市住房和建设局拟发布《深圳市建设工程新技术推广目录（2022年）》。现将列入推广目录的10项新技术予以公示，公示期为自本公示发布之日起5个工作日。

公示期内，任何单位和个人如对公示新技术有异议，均可提出书面意见。单位意见需加盖公章，个人意见需署真实姓名和联系电话。

联系人：张韵梓，电话：0755-83782156；

地 址：深圳市福田区振兴路1号北楼408室，邮编：518028。

附件：深圳市建设工程新技术推广目录（2022年）

深圳市住房和建设局

2022年12月6日

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深圳市建设工程新技术推广目录（2022年）.doc

附件

深圳市建设工程新技术推广目录（2022 年）

序号	新技术名称	技术要点	适用范围	典型案例名称	申报单位
10	模块化轨道颗粒阻尼器减振降噪技术	针对轨道交通系统波磨病害以及轨道结构振动和噪声问题，研发由模块化钢轨颗粒阻尼器。利用颗粒间及颗粒与阻尼器腔体间的碰撞与摩擦，将钢轨振动能量消散成热能。通过控制不同模块内颗粒的材质和填充比，可便各模块灵活调整相关噪声控制频宽。通过建立结合离散元方法和深度迁移学习的动力数值模型，可快速得到颗粒阻尼器的最优设计参数。	轨道交通工程	深圳市城市轨道交通 5 号线、港铁观塘线九龙湾站	香港理工大学深圳研究院

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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Email: yiqing.ni@polyu.edu.hk
Website: https://www.polyu.edu.hk/cnerc-rail