

# **2025 IEEE International Conference on Intelligent Rail Transportation (ICIRT 2025)**

**Beijing, China  
11-12 October 2025**



**IEEE Catalog Number: CFP25IRC-POD  
ISBN: 979-8-3315-9752-8**

**Copyright © 2025 by the Institute of Electrical and Electronics Engineers, Inc.  
All Rights Reserved**

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

***\*\*\* This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP25IRC-POD
ISBN (Print-On-Demand):	979-8-3315-9752-8
ISBN (Online):	979-8-3315-9751-1

**Additional Copies of This Publication Are Available From:**

Curran Associates, Inc  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: (845) 758-0400  
Fax: (845) 758-2633  
E-mail: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

## TABLE OF CONTENTS

A Review of Deep Learning-Based Fault Diagnosis Techniques for Axlebox Bearings in Rail Vehicles .....	1
<i>Lianxin Wu, Xiaojie Sun</i>	
Zero-Shot Framework for Locating Unknown Bogie Faults using Transformer Architecture .....	7
<i>Yiming Zhang, Na Qin, Deqing Huang, Quanbo Ge</i>	
Robustness Evaluation of Rail Track Detection Models Under Natural and Adversarial Disturbances .....	13
<i>Xiaotong Cui, Wei Zheng, Jinyu Xiao, Lifeng Zhang, Gang Li, Junfeng An</i>	
Prediction of Geometric Degradation in Heavy-Haul Railway Tracks Based on Integrated Deep Learning .....	19
<i>Hao Liang, Mingduan Liu, Yang Chu, Yuan Cao, Yongkui Sun, Yizhou Zhou</i>	
MCFS: Multi-Channel Causal Feature Selection for Subway Bogie System Fault Diagnosis.....	25
<i>Fei Wang, Chongchong Yu, Weichen Xu, Hao Tian</i>	
A Knowledge Graph-Assisted Operation and Maintenance Decision-Making Approach for Virtual Entities of Railway Turnout Equipment .....	31
<i>Dong Li, Haixiang Lin, Zhenhai Zhang</i>	
Integrated Optimization of Suburban Railway Train Timetable, Rolling Stock Circulation and Train Platforming.....	37
<i>Jinke Gao, Jing Teng, Zhixia He, Shiping Shan, Yucheng Wang, Yong Zhang, Chuyu Duan, Yiwen Lan</i>	
Crew Scheduling for Urban Rail Transit Incorporating Resource Sharing and Personal Preferences .....	44
<i>Gehui Liu, Ling Liu, Hua Jin, Qihe Zhang, Yafei Liu, Qing Li</i>	
Relations Between Objectives in Additional Train Scheduling.....	50
<i>Elisabeth Brugger, Paola Pellegrini, Francesco Corman</i>	
An Adaptive Approach to Disturbances in Rail Systems Utilising BDI Agents.....	56
<i>Kevin Malysiak, Fenghui Ren</i>	
Metro Train Rescheduling with Flexible Composition and Additional Services for Disruptive Passenger Demand.....	62
<i>Krishdyology M. Thywoo, Yihui Wang, Kun Ji, Miaomiao Ding</i>	
Train Snowfall LiDAR Point Cloud Generation Method Based on Unreal Engine and Physics Simulation .....	68
<i>Xiao Luo, Lei Yuan, Guodong Wei</i>	
Towards Pedestrian Trajectory Prediction in Tram Environments for Safe and Efficient Autonomous Tram Systems: Dataset Development .....	74
<i>Supatat Hovanotayan, Kimihiko Nakano, Tetsuya Takata, Hiroyuki Nagasawa, Makoto Ueda, Kazuya Sakakidani</i>	
RAG Applications in Lightweight LLMs: Boosting Reliability for Text Generation in Railway .....	80
<i>Ruize Zhang, Jing Xun, Yuchen Luo, Yalan Chen, Kun Qian, Sishuo Wang</i>	

Neural Network Impedance Identification Method Based on Expression Embedding .....	86
<i>Li Shixiang, Gang Jianlei, Liu Xiaobin, Peng Yang, Xu Zhenzhong</i>	
Trajectory Optimization for High-Speed Railway Virtual Coupling: A Time Headway Approach with Convex Programming.....	92
<i>Ning Huang, Chaoxian Wu, Shaofeng Lu, Zhongbei Tian, Yougang Sun</i>	
EMU Circulation Optimization with Deep Embedded Clustering-Enhanced Operational Characteristic Objective Formulation.....	98
<i>Jing Teng, Zihan Huang, Chenlu Zhu, Zhikang Ying, Weixing Shao</i>	
Virtual Coupling Control for Metro Train Arrival Under Short-Turning Operation.....	104
<i>Yuanhang Li, Yafei Liu, Linbin Chen, Gehui Liu, Zhanbo Sun, Jinzhang Kou</i>	
Cooperative Nonlinear Model Predictive Control for Multiple Locomotives of Heavy Haul Train on Long Steep Downhill Sections .....	110
<i>Ran Lu, Miao Zhang, Shuai Su</i>	
Safety and Performance Cruise Controller for Virtual Coupling Trains.....	116
<i>Xuanjun Zong, Xiangbin Liu, Jiang Wang</i>	
A Regenerative-Energy-Aware Train Operation Method Based on Deep Reinforcement Learning.....	122
<i>Minxue Fu, Jing Xun, Yalan Chen, Zicong Zhao, Dian Yi, Yuchen Luo</i>	
Network Link Health Assessment Method Based on Cloud Model and Viktor.....	128
<i>Zhipeng Wang, Yakun Zuo, Limin Jia, Ning Gao, Fanpeng Kong</i>	
A Modular and Interpretable LiDAR Point Cloud Object Detection Framework .....	136
<i>Jiahui Li, Rui Wang, Shuai Su</i>	
Context-Aware LiDAR Point Cloud Segmentation with Expertised Decision Strategy.....	142
<i>Chuqiao Zhang, Rui Wang, Shuai Su</i>	
Improved RT-DETR for Passenger Flow Detection in Subway Stations.....	148
<i>Hongjiang Pan, Xinjun Gao, Shuai Su</i>	
Reinforcement Learning Based Parameter Identification Method for Train Dynamics Model .....	154
<i>Yuxuan Wan, Zhongtian Liu</i>	
Open World Object Detection with Explicit Objectiveness Measure .....	162
<i>Tengkun Yang, Haochen Zhang, Rui Wang, Shuai Su</i>	
XGBoost-Based Train Delay Prediction.....	168
<i>Jingjie Du, Jian Wang, Hui Zhang, Tao Wang, Runmei Li, Yanran Ji</i>	
Optimal Sizing and Power Scheduling of Traction Power Supply System with PV and Hybrid Energy Storage .....	174
<i>Bolun Zhang, Fuwang Chen, Ying Xue, Zhixin He, Shaofeng Lu</i>	
Automatic Operation Adjustment for Urban Rail Trains Under Small-Scale Temporary Speed Restrictions: A Two-Stage Method Approach.....	181
<i>Xiao Lin, Xueliang Wu, Shuai Su</i>	
Elastic Train Platforming in Large High-Speed Railway Stations Considering Platform and Track Operation.....	187
<i>Jinke Gao, Jing Teng, Siyuan Qu, Congli Zhang, Yu Li, Yiwen Lan, Linyu Wu</i>	

A Data-Driven Problem Reduction Framework for Local Train Rescheduling in Station Areas .....	194
<i>Sebastian Sehmisch, Christopher Szymula, M. Tabish Haque, Nikola Bešinovic</i>	
Dynamic Modeling and Validation of Vehicle-Track Coupling for Heavy-Haul Railways.....	200
<i>Yuefa Chen, Xianhong Meng, Shuai Su, Du Shang</i>	
A Feature-Extraction-Based Coupler Force Prediction Method for Heavy Haul Trains .....	206
<i>Yufei Yan, Lijie Chen, Jinke Shi, Yuqiang He, Zhanyuan He, Ming Chai</i>	
Robustness and Cascading Failure Dynamics in Urban Rail Systems: Integrating Global State Feedback Mechanisms.....	212
<i>Tianliang Zhu, Hui Li, Xianying Zhang, Yixuan Wu, Chenxi Zhao, Yaqi Guo</i>	
Towards Railway Domain Adaptation for LiDAR-Based 3D Detection: Road-to-Rail and Sim-to- Real via SynDRA-BBox.....	218
<i>Xavier Diaz, Gianluca D'Amico, Raul Dominguez-Sanchez, Federico Nesti, Max Ronecker, Giorgio Buttazzo</i>	
Optimal Yaw Attitude Tracking Control of Maglev Cars via Reinforcement Learning-Based Model Predictive Control.....	226
<i>Jiaheng Shi, Jialin Li, Zhihao Ke, Yining Chen, Zhengyan Li, Zigang Deng</i>	
Design of RBF-PID Levitation Controller with Acceleration Compensation .....	232
<i>Shenghao Li, Guang Yang, Pengcheng Hu, Hongze Xu</i>	
Adaptive MPC Method for Virtual Coupling Trains of the Middle-Speed Maglev Line .....	238
<i>Haimidan Xiermaimaiti, Guiyang Sun, Xubin Sun, Hongze Xu, Junfeng Cui</i>	
An OCE-RL Framework for Coordinated Control of Autonomous Train Virtual Coupling.....	244
<i>Wei Lin, Yang Zhao, Susu Huang, Hongmin Gao, Miao Zhang, Dengke Xu</i>	
Object Detection and Binocular Depth Estimation in Railway Localization Applications .....	250
<i>Haoyu Wang, Debiao Lu, Hui Zhang, Baigen Cai, Jian Wang, Jiang Liu, Wei Jiang</i>	
Dynamic Detection of Electromagnetic Deviant Interference in Railway Electromagnetic Environment Based on PSO-Optimized Random Forest.....	256
<i>Jiangfa Xiong, Shiwu Yang, Chang Liu, Zijun Wei, Peihao Xun</i>	
Availability Evaluation of Urban Rail Transit Communication System Based on Fuzzy Bayesian Network.....	262
<i>Zhibin Liao, Bo Yang, Zhang Zhang, Song Fu, Xuan Bai, Fan Wang</i>	
Strip-Convolution Feature Fusion Network for Foreign Object Intrusion Detection in Railway Scene .....	268
<i>Ning Wang, Junzhe Li, Tao Ruan</i>	
Distributed Path Planning for Multi-UAV Systems Integrating Fish Swarm Behavior Strategies .....	274
<i>Jiaan Nie, Runmei Li, Zhang Hui</i>	
Few-Shot Object Detection for Remote Sensing Images Based on Fine-Tuning .....	280
<i>Jun Yang, Siyi Li</i>	
Infrared and Visible Image Fusion Based on Multi-Feature Prior and Dual-Discriminator GAN .....	286
<i>Yu Shen, Yuxiang Jiang, Jiaying Liu, Jing Song</i>	

Distributed Cooperative Control and Energy Efficiency Optimization of EMUs Based on Power Unit Switching Strategy .....	294
<i>Zheng Liu, Qingyuan Wang, Pengfei Sun</i>	
Transforming LLMs into Domain Experts: A Case Study of Train Trajectory Evaluation.....	301
<i>Yiding Yu, Pengfei Sun, Hongyi Zhao, Qingyuan Wang, Chao Liu</i>	
Model-Free Consensus Tracking for Networked Multiple HSTs Against Intermittent Measurement.....	309
<i>Wei Yu, Zhongkui Li, Deqing Huang</i>	
Train Eco-Driving Problems with Time-Dependent Speed Limits.....	315
<i>Zhuang Xiao, Qingyuan Wang, Xiaoyun Feng</i>	
Multi-Objective Train Speed Trajectory Optimization via GRU-DDPG with Decomposed Fuzzy Adaptive Weighting.....	321
<i>Yutian Tian, Runmei Li, Xiaoguang Li</i>	
Energy-Saving Operation Control Method for Trains Considering Air Brake Wear .....	327
<i>Chenghao Cui, Jing Xun, Chaoxu Gao, Qianshu Xue, Yalan Chen, Minxue Fu</i>	
Broadband Feedforward Active Noise Control with a New Variable Step-Size Filtered-X LMS Algorithm for High-Speed Trains.....	333
<i>Kexin Liang, Runmei Li, Shuyun Dong</i>	
Energy-Efficient Trajectory Optimization of Freight Train on Steep Gradients with Dynamic Programming.....	339
<i>Qiangqiang Liu, Xiaoyun Feng, Juxia Ding, Yu Rao, Pengfei Sun, Qingyuan Wang</i>	
Operation Optimization of Heavy Haul Train Considering Longitudinal Impulse Suppression: A DQN Approach.....	346
<i>Cong Wang, Qingyuan Wang, Pengfei Sun</i>	
An Optimization Method of Heavy Haul Train Driving Strategy Based on Dueling DQN .....	353
<i>Qida Si, Lu Jiang, Qi Wang, Youbin Su, Zhiming Xiao, Yuxuan Han, Ming Chai</i>	
A Preview-Based Model Predictive Control Strategy for Lateral Suspension in Intelligent Railway Vehicles .....	359
<i>Yulin Liao, Youwei Song, Donghong Ning, Haiping Du, Shihai Xue, Zhiyuan Liu</i>	
Train Speed Tracking Control Method Based on Adaptive Fuzzy Control System.....	365
<i>Yunfei Li, Shiji Xin, Runmei Li</i>	
Analysis of 5G Signal Coverage Model and Propagation Loss in Railway Tunnels.....	371
<i>Yuqi Qin, Jinbai Zou, Xiaoyong Liu, Lingxiao Chen</i>	
An Adaptive Optimization Method for 5G-R Handover Parameters Based on Multi-Domain Information Fusion .....	377
<i>Zixuan Zhou, Qi Wang, Jie Sheng, Bing Bu, Kangwei Wang, Cheng Wu</i>	
ARBS: A Traffic-Detection Scheduler for Reliable Video Transmission in Subway Scenarios.....	383
<i>Yutong Sun, Xiaoya Zhang, Wenxuan Qiao, Ziang Fan, Yuyang Zhang, Ping Dong</i>	
A Dynamic Channel-State-Based Adaptive Image Compression Strategy for High-Speed Railways .....	390
<i>Anna Dai, Mingduan Liu, Peng Li, Xinjian Han, Yang Chu, Yuntong An, Yongkui Sun, Yuan Cao</i>	

System Design and Performance Test in Urban Rail Transit Communication System Based on 5G Public Network.....	396
<i>Yu Liu, Hongli Zhao, Li Zhu</i>	
Emulation and Implementation of High-Precision Doppler Shift in High-Speed Train Communications.....	402
<i>Bowen Yin, Lei Xiong, Kunye Hong, Hao Zhou, Haobo Zhang</i>	
A Standardized Behavior Sequence Risk Assessment Framework from Human-Machine Interaction Perspective: A Case Study of Train Driving.....	408
<i>Kun Wang, Haifeng Bao, Weining Fang</i>	
The Influence of Reflectivity on MEMS Lidar SNR.....	414
<i>Bin Zhang, Xinru Ma, Xiaoping Ma</i>	
Urban Train Resistance Parameter Calibration for Optimal Train Control.....	419
<i>Rang Xu, Fuwang Chen, Shaofeng Lu</i>	
Priority Scheduling and Cooperative MAC Protocol for Train-to-Train Communication.....	425
<i>Yilun Yang, Ruizhe Yang, Meng Li, Xuan Wang, Pengbo Si</i>	
Cybersecurity Risk Assessment of Wheel Slide Protection System in Railways .....	431
<i>Benghenane Yasmine, Lounis Ahmed, Sallak Mohamed</i>	
A Hybrid CNN+BiLSTM+Attention Model for Improved Train Delay Prediction .....	439
<i>Hehan Yu, John Easton, Yiqing Liu, Clive Roberts</i>	
Fault Diagnosis of ZPW-2000A Track Circuit Based on GAF-CNN-Channel Attention.....	445
<i>Hu Weijia, Zhang Yadong</i>	
Fault Diagnosis Method of Rail Transmit Communication Equipment Based on Text Classification .....	452
<i>E. Ziyang, Hongli Zhao, Li Zhu</i>	
Energy Saving Operation Strategy for Urban Rail Transit Train Control.....	458
<i>Yuan Tian, Hongyuan Deng, Wenbo Wei, Xiaomin Wang</i>	
Research on Fault Maintenance Support Method for All - Electronic Computer Interlocking Equipment Based on Two - Stage Retrieval Enhancement.....	462
<i>Peng Yang, Zhao Mengyao, Guo Wei, Xue Hongyi, Liu Yiming, Qin Fayuan</i>	
Digital Maintenance Transformation in Communication and Signaling for Urban Rail Transit Under Large-Scale Network Operation .....	468
<i>Lei Wang, Jingyun Zheng</i>	
Dynamic Estimation of Track Irregularities via Deep Learning.....	472
<i>Yaofeng Tian, Xiaoli Hao, Xianfu Sun, Fei Yang</i>	
High-Speed Railway Track Circuit Interference Detection and Identification.....	478
<i>Biao Zhang, Jie Ren, Dan Zhang, Kaiwen Jiang</i>	
Study on the Frequency-Dependent Impedance Characteristics of High-Speed Railway Traction Return Current Paths .....	484
<i>Shaotong Chu, Qiang Wang, Hongwei Yan, Shiwu Yang</i>	
Effects of Curved Cables on Radiated Emissions of Train-End Interconnect Cables .....	489
<i>Kaiwen Jiang, Dan Zhang, Jinbao Zhang, Biao Zhang</i>	

**Author Index**