

Lecture Notes in Electrical Engineering

Volume 868

Series Editors

Leopoldo Angrisani, Department of Electrical and Information Technologies Engineering, University of Napoli Federico II, Naples, Italy

Marco Arteaga, Departament de Control y Robótica, Universidad Nacional Autónoma de México, Coyoacán, Mexico

Bijaya Ketan Panigrahi, Electrical Engineering, Indian Institute of Technology Delhi, New Delhi, Delhi, India

Samarjit Chakraborty, Fakultät für Elektrotechnik und Informationstechnik, TU München, Munich, Germany

Jiming Chen, Zhejiang University, Hangzhou, Zhejiang, China

Shanben Chen, Materials Science and Engineering, Shanghai Jiao Tong University, Shanghai, China

Tan Kay Chen, Department of Electrical and Computer Engineering, National University of Singapore, Singapore, Singapore

Rüdiger Dillmann, Humanoids and Intelligent Systems Laboratory, Karlsruhe Institute for Technology, Karlsruhe, Germany

Haibin Duan, Beijing University of Aeronautics and Astronautics, Beijing, China

Gianluigi Ferrari, Università di Parma, Parma, Italy

Manuel Ferre, Centre for Automation and Robotics CAR (UPM-CSIC), Universidad Politécnica de Madrid, Madrid, Spain

Sandra Hirche, Department of Electrical Engineering and Information Science, Technische Universität München, Munich, Germany

Faryar Jabbari, Department of Mechanical and Aerospace Engineering, University of California, Irvine, CA, USA

Limin Jia, State Key Laboratory of Rail Traffic Control and Safety, Beijing Jiaotong University, Beijing, China

Janusz Kacprzyk, Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland

Alaa Khamis, German University in Egypt El Tagamoa El Khames, New Cairo City, Egypt

Torsten Kroeger, Stanford University, Stanford, CA, USA

Yong Li, Hunan University, Changsha, Hunan, China

Qilian Liang, Department of Electrical Engineering, University of Texas at Arlington, Arlington, TX, USA

Ferran Martín, Departament d'Enginyeria Electrònica, Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain

Tan Cher Ming, College of Engineering, Nanyang Technological University, Singapore, Singapore

Wolfgang Minker, Institute of Information Technology, University of Ulm, Ulm, Germany

Pradeep Misra, Department of Electrical Engineering, Wright State University, Dayton, OH, USA

Sebastian Möller, Quality and Usability Laboratory, TU Berlin, Berlin, Germany

Subhas Mukhopadhyay, School of Engineering & Advanced Technology, Massey University, Palmerston North, Manawatu-Wanganui, New Zealand

Cun-Zheng Ning, Electrical Engineering, Arizona State University, Tempe, AZ, USA

Toyoaki Nishida, Graduate School of Informatics, Kyoto University, Kyoto, Japan

Federica Pascucci, Dipartimento di Ingegneria, Università degli Studi "Roma Tre", Rome, Italy

Yong Qin, State Key Laboratory of Rail Traffic Control and Safety, Beijing Jiaotong University, Beijing, China

Gan Woon Seng, School of Electrical & Electronic Engineering, Nanyang Technological University, Singapore, Singapore

Joachim Speidel, Institute of Telecommunications, Universität Stuttgart, Stuttgart, Germany

Germano Veiga, Campus da FEUP, INESC Porto, Porto, Portugal

Haitao Wu, Academy of Opto-electronics, Chinese Academy of Sciences, Beijing, China

Walter Zamboni, DIEM - Università degli studi di Salerno, Fisciano, Salerno, Italy

Junjie James Zhang, Charlotte, NC, USA

The book series *Lecture Notes in Electrical Engineering* (LNEE) publishes the latest developments in Electrical Engineering - quickly, informally and in high quality. While original research reported in proceedings and monographs has traditionally formed the core of LNEE, we also encourage authors to submit books devoted to supporting student education and professional training in the various fields and applications areas of electrical engineering. The series cover classical and emerging topics concerning:

- Communication Engineering, Information Theory and Networks
- Electronics Engineering and Microelectronics
- Signal, Image and Speech Processing
- Wireless and Mobile Communication
- Circuits and Systems
- Energy Systems, Power Electronics and Electrical Machines
- Electro-optical Engineering
- Instrumentation Engineering
- Avionics Engineering
- Control Systems
- Internet-of-Things and Cybersecurity
- Biomedical Devices, MEMS and NEMS

For general information about this book series, comments or suggestions, please contact leontina.dicecco@springer.com.

To submit a proposal or request further information, please contact the Publishing Editor in your country:

China

Jasmine Dou, Editor (jasmine.dou@springer.com)

India, Japan, Rest of Asia

Swati Meherishi, Editorial Director (Swati.Meherishi@springer.com)

Southeast Asia, Australia, New Zealand

Ramesh Nath Premnath, Editor (ramesh.premnath@springernature.com)

USA, Canada:

Michael Luby, Senior Editor (michael.luby@springer.com)

All other Countries:

Leontina Di Cecco, Senior Editor (leontina.dicecco@springer.com)

**** This series is indexed by EI Compendex and Scopus databases. ****

More information about this series at <https://link.springer.com/bookseries/7818>

Yong Qin · Limin Jia · Jianying Liang ·
Zhigang Liu · Lijun Diao ·
Min An
Editors

Proceedings of the 5th
International Conference
on Electrical Engineering
and Information
Technologies for Rail
Transportation (EITRT) 2021

Rail Transportation System Safety
and Maintenance Technologies

 Springer

Editors

Yong Qin
Beijing Jiaotong University
Beijing, Beijing, China

Limin Jia
Beijing Jiaotong University
Beijing, Beijing, China

Jianning Liang
CRRC Qingdao Sifang Co., Ltd.
Qingdao, Shandong, China

Zhigang Liu
Beijing Jiaotong University
Beijing, Beijing, China

Lijun Diao
Beijing Jiaotong University
Beijing, Beijing, China

Min An
University of Salford
Salford, UK

ISSN 1876-1100

ISSN 1876-1119 (electronic)

Lecture Notes in Electrical Engineering

ISBN 978-981-16-9912-2

ISBN 978-981-16-9913-9 (eBook)

<https://doi.org/10.1007/978-981-16-9913-9>

© Beijing Oriental Sun Cult. Comm. CO Ltd 2022

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd. The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Contents

Research on Alarm Correlation Analysis for EMU Train Based on Association Rule Mining Algorithm	1
Chong Wang, Lide Wang, Yu Qiu, Yueyi Yang, Yangyang Li, and Ping Shen	
Feasibility Study of Li-ion Battery Based Portable Train Starter	9
Yuchao Wang, Hongliang Duan, Haifeng Hong, Jing Liu, Chang Chen, Hang Yan, and Wenrui Wang	
Research on Algorithm of Wheelset Profile Extraction Based on Clustering and Huff Transform	17
Yihui Zhang, Zongyi Xing, Jun Li, and Yong Zhang	
Research on the Influence of Maximum Disturbance of Track Steel Beam on the Operation Performance of Low Speed Maglev Vehicle	26
Yixin He, Jianyong Zuo, Tianpeng Wang, Xinwei Wang, and Sufen Zhou	
Online Fault Diagnosis of Multi-function Vehicle Bus Based on Decision Tree	36
Ye Li, Lide Wang, Zhenwei Jia, Huizhen Wang, and Liyong Xu	
Battery SOC Estimation Method Based on BP Neural Network Optimized by Genetic Algorithm	45
Xingyuan Ma, Yang Liu, Chenxu Li, Geng Tang, Gang Zhang, and Ruichang Qiu	
Health Assessment Method for MVB Network	57
Huizhen Wang, Lide Wang, Yueyi Yang, and Ye Li	
Design and Application of Dynamic Test Platform for Railway System Protective Relays	66
Rui Shen, Zhengqing Han, Suping Liu, and Shibin Gao	

Concrete Crack Detection Based on Hybrid Residual Network and Graph Convolutional Network	74
Xiaosheng Huang, Xiao Zhou, and Runtao Duan	
Simulation of EMU: Vehicle Energy Consumption Evaluation	82
Ruiqi Mu, Feng Gao, Hongwei Zhao, Fei Xia, and Yufei Fu	
Health Evaluation Method for Multi-function Vehicle Bus Network	90
Jiaren Wang and Lei Yan	
Emergency Resource Scheduling Model of Rail Transit Based on Transportation Capacity	99
Xiangli Ying, Xu Jie, and Song Qiang	
Study on Thermal Insulation Material Selection for Lithium-Ion Power Battery System	110
Zhuomin Zhou, Xingzhen Zhou, Xiangsheng Zhou, Mao Li, Duankai Li, and Chen Deng	
System Design Based on the Dynamic Simulation Platform of Urban Rail Transit Traction Power Supply	117
Biao Li, Zhou Ge, Chaohui Duan, and Ying Zhu	
Research on Thermal Runaway Behavior of Lithium Titanate Anode Battery Based on Differential Abuse Conditions	125
Tao Xing, Shijie Liu, Xingzhen Zhou, Minming Gong, and Weinan Huang	
RUL Prediction of Railway PCCS Based on Data-Driven Method	133
Tianke Zhao	
Research on the Construction of Human-Factor Complex Risk Network Model for Urban Rail Transit Operation	146
Tiange Zhang, Jia Limin, Chenyang Zhao, and Yanhui Wang	
An Experimental Study on Overcharge Behaviors of Lithium-Ion Power Battery with Lithium Titanate Anode	153
Zhuomin Zhou, Xingzhen Zhou, Xiangsheng Zhou, Junxiang Zheng, Duankai Li, and Binbin Jian	
Finite Element Analysis of the Stress and Life of Cylindrical Bearing Roller of High-Speed Railway Motor	162
Guang Han, Qingbin Tong, and Guoping An	
IGBT Module Life Prediction Based on Rain Flow Method and Junction Temperature Analysis	171
Xiaobing Li and Mingchao Zhou	
Design and Research of Accelerated Aging Test Platform for IGBT Power Module	179
Mingchao Zhou, Lei Wang, Mengxue Guo, Yanbei Sha, Qiuli Liu, and Lijun Diao	

Scheme Design and Engineering Application of Train Auxiliary Power Supply System 187
 Jinyan Li, Mengzhu Wang, Lei Wang, and Lijun Diao

A Pantograph Dynamic Comprehensive Detection System Based on Edge Calculation for Straddle Type Monorail Vehicle 195
 Guojun Zhuang, Kaiyan Dong, Chao Chen, Shenghua Wang, Yaqi Ding, and Zekun Liu

Application of Gas Detection Device Based on LoRa Wireless Communication in Rail Transit Pile Foundation Well 211
 Wendong Gong, Qinglong Zhao, Fanhua Zeng, Lixin Xu, and Zechen Han

Fast Obstacle Detection Platform Based on Yolo 218
 Wenhua Ma, Xin Wang, and Baohua Wang

System Resilience Assessment Method of Urban Rail Transit Train Traction System Base on RSI 227
 Ziyu Wang and Yanhui Wang

Structural Parameters Design of Dual-Crystal Piezoelectric Beam Vibration Energy Harvesters for Rail Vehicles Based on Seagull Optimization Algorithm 236
 Qianwen Zhong, Jiahui Sun, Shubin Zheng, Lele Peng, Xin Zhang, and Xiaodong Chai

Design and Implementation of Integrated Debugging and Testing Platform for Distribution Automation Terminal 247
 Xialing Liu, Jun Zhou, Yi Fan, Qiang Zhou, Chen Chen, and Zhaorui He

Distributed Fault Diagnosis System of Mining Dump Truck Based on Server 256
 Xianghui Liang, Mijiang Li, Jian Zhou, Qianqian Xie, and Lei Wang

Intelligent Fault Diagnosis System of Mining Dump Truck Based on Fault Tree and Neural Network 264
 Hongri Gao, Lishan Li, Yan Mu, Junliang Cai, and Weibin Mou

A Bidirectional Half-Bridge Three-Level LLC Converter 272
 Haijie Jia, Dongdong Hou, Long Yan, Menglei Ding, and Xiang Zhang

Research on Track Condition Monitoring Based on Fiber Bragg Grating Sensing Technology 280
 Yichen Li, Zhiqiang Rao, Yulin Zhao, Hui Chang, and Ziyi Li

Research on Verification Method of PHM Metrics Based on Fault Code 289
 Jie Zheng, Yanming Li, and Yiqi Li

Safety Analysis Research of Train Integrity Based on STPA	297
Weina Song, Fei Yan, Miao Zhang, and Peng Wang	
Research on Anti-collision Early Warning System of Rail Train Based on Wavelet Transform	306
Tuo Shen, Lanxin Xie, Jinhuang Zhou, and Cong Shi	
Development of Traction Control Unit Control System for PHM Based on Zynq UltraScale+	326
Jia Hao, Han Wei, Shen Di, and Ruichang Qiu	
Assessment Method of Contactor Degradation Based on Cumulative Wear	332
Peng Wu, Chuanyu Zhao, and Ruichang Qiu	
Ultrasonic Guided Wave Communication Based on Pulse Position Modulation in Railways	338
Lei Yuan, Yuan Yang, Xiaobing Dang, and Jiakuan He	
Analysis of Influencing Factors of Urban Rail Transit Dispatching Based on Fuzzy DEMATEL-ISM	346
Yitong Wang and Yanhui Wang	
Reliability Analysis of Complex Mechanical Systems	354
Yu Zhang, Zhuo Wang, and Yanhui Wang	
Rolling Bearing Fault Diagnosis Method with Adaptive CEEMD and Cyclic Spectrum Coherence	362
Yu Zeng, Yong Qin, Wenlong Yang, Shengqiang Liu, Linlin Huang, and Rui Wang	
Performance Comparison of Locomotive Auxiliary Power Supply Under Different Conditions	371
Qubo Xie, Jinyan Li, and Baohua Yu	
Railway Perimeter Disaster Image Monitoring Method Based on YOLOV4_Lite	380
Weitao Ren, Zhengyu Xie, Yong Qin, and Feng Lin	
Railway Pedestrian Intrusion Detection Using Onboard Forward-Viewing Camera	388
Yongling Li, Bing Fu, Yong Qin, Ruocen Yuan, Zhiwei Cao, Zhengyu Xie, and Yang Gao	
Track Defect Recognition Algorithm Based on Deep Learning	397
En-quan Fang, Kun-shan Yang, and Ming Zeng	
Fault Diagnosis of Impedance Match Bond in High-Speed Railway Concerning Risk Assessment	409
Chang Liu, Shaotong Chu, Shiwu Yang, and Guangxin Han	

Research on Key Technologies of Cloud-Side Collaboration for Urban Rail Intelligent Security 421
 Chao Zhou, Chengxin Du, Zhifei Wang, Yukun Meng, and Peiyao Han

Rolling Bearing Fault Diagnosis Based on Improved GRU 430
 Xiangyu Ren and Yong Qin

Intelligent Safety Detection System of Freight Car Based on 3D Image Technology 441
 Yao He, Xiao Sun, Wei Wu, Ze Kun Liu, and Guo Jun Zhuang

Evaluation of Levitation Control Performance of Maglev Train Based on Fractal Analysis 452
 Tao Wen, Wentao Xia, Xu Zhou, and Zhiqiang Long

Intuitionistic Fuzzy FMEA Approach for Key Component Identification of Rail Bogie 460
 Zhenyu Zhang, Zongyi Xing, and Yong Qin

A Data Driven Simulation Model for Investigating Collision Avoidance Behavior of Pedestrians in Subway Stations 467
 Zhe Zhang, ShuRong Yan, and JianYuan Guo

Research on the Health Evaluation and Prediction of Switch Machine 475
 Jianfeng Zeng, Gang Li, Peiling Lu, Yong Yang, Shangzhi Xu, and Zhipeng Li

A Multi-dimensional Health Index Calculation Algorithm for ZPW-2000A Track Circuit 483
 Zhengang Li, Gang Li, Peiling Lu, Yong Yang, Shangzhi Xu, and Zhipeng Li

Adaptive Fault Diagnosis System for Railway Track Circuits 491
 Xigao Liu, Xiaoliang Wang, and Gaitang Han

Fault Detection of High Voltage Circuit Breaker Opening and Closing Coil Based on Compressed Sensing 499
 Hong Qi, Weiguang Dong, and Zhouwei Zhang

Research on Fault Prediction of High-Speed Train Auxiliary Power Supply System Based on LSTM 507
 Zhuo Wang, Honghui Dong, Jie Man, Liming Jia, and Yong Qin

Autonomous Fault Identification Method of Train Axle Bearings Based on Ginigram and Squared Envelope Spectrum 516
 Qitian Zhong, Ge Xin, Zhe Li, Yifan Ding, and Limin Jia

Data-Driven Ontology Construction Method for Railway Derailment Accidents	524
Ruhao Zhao, Xiaoping Ma, Honghui Dong, Han Yan, Fei Chen, and Limin Jia	
Research on the Inverter Fault Evolution in Permanent Magnet Direct Drive Traction Drive System	534
Zheng Liu and Gang Niu	
Fault Diagnosis of Train Wheelset Bearings Based on Improved Joint Distribution Adaptation	542
Yifan Ding, Ge Xin, Zhe Li, Qitian Zhong, and Limin Jia	
A Monitoring and Early Warning Method for Railway Infrastructure Using Beidou Based on the Grey Model	550
Zhiyuan Lu, Peifen Pan, Tao Tao, Xuejiao Bai, Han He, Tao Liu, and Lianghui Zhang	
IGBT Open-Circuit Fault Diagnosis for MMC Based on Model Prediction	564
Qinyue Zhu, Daquan Li, Xitang Tan, Xiuhan Huang, and Jingran Xu	
Study on the Efficiency of Video Scene Detection Based on YOLO Series	575
Yue Shen, Han Yan, Yuwei Zhang, and Zhengyu Xie	
Bearing Fault Diagnosis Method of Bearing Based on LSTM Auto-Encoder	582
Zhencong Lu, Yong Qin, Xiaoqing Cheng, Shunjie Zhang, and Yu Zeng	
Research on Safety Identification of Key Components of Maglev Train Based on Multi-layer Perceptron	592
Zhaohui Liu, Wen Li, Jun Chen, and Haoqi Guo	
Comprehensive Analysis of High-Speed Railway Network Based on Complex Network Theory	603
Xuelei Meng, Yahui Wang, Lei Li, and Wanli Xiang	
Segmentation of Maize Ear Bold Tip Based on U-Net	609
Lijuan Shi, Xingang Xie, and Yang Zhang	
Detection and Simulation of Adhesion Coefficient of Residual Snow Pavement on Urban Road	617
Kuo Zhao, Bing Wang, Xiaojun Liu, and Zhengxiang Cao	
Research on Laser Point Cloud Filtering Algorithm Based on Configuration Characteristics of Highway Seismic Disaster	625
Weigang Zeng, Bing Wang, Jizhong Zhang, Chenyuan Ma, and Haoran Liu	

A Study on Automatic Train Coupling and Uncoupling of Urban Rail Transit Under FAO 635
Xiangyang Lu, Fan Jiang, Yong Liu, Zheng Wen, Kai Li, and Jie Yu

Analysis of Stopping Accuracy Deviation of Urban Rail Transit Train in ATO Driving Mode 649
Miao Lu, Dongxiu Ou, Zhichen Hua, and Lizhong Gu

Safety Analysis on the Process of Automatic Train Coupling in Urban Rail Transit. 662
Haigang Cui and Dongxiu Ou

Transition Control of Virtual Coupling Train Formation Based on Model Predictive Control 673
Yuanxiang Yang, Dongxiu Ou, Yu Liu, and Decun Dong

Optimization for Operation Planning and Pricing of Intercity Railway in Terms of Carbon Emission. 685
Yuling Ye, Jiaqi He, Kai Liu, and Pengchao Chen

Design and Implementation of Automatic Marshalling for Intelligent Driving Locomotive of Heavy-Haul Train 693
Tiebing Li, Chaokun Xiong, Fan Jiang, Long Zhu, Kai Li, and Sheng Zeng

The Fault Diagnosis Method of Rolling Bearing Based on CEEMDAN 702
Libo Liu and Qingbin Tong

Author Index. 711