

2021 3rd International Conference on System Reliability and Safety Engineering (SRSE 2021)

**Harbin, China
26-28 November 2021**



**IEEE Catalog Number: CFP21BG3-POD
ISBN: 978-1-6654-0161-6**

**Copyright © 2021 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:	CFP21BG3-POD
ISBN (Print-On-Demand):	978-1-6654-0161-6
ISBN (Online):	978-1-6654-0160-9

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
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

2021 3rd International Conference on System Reliability and Safety Engineering (SRSE) **SRSE 2021**

Table of Contents

Preface	xiv
Conference Organization	xv

SRSE 2021

Health Prediction for UAV Motors Based on Weak Degradation Characteristics	1
<i>Keyong Shao (Northeast Petroleum University, China), Yunhao Xu (Northeast Petroleum University, China), and Wenhui Fan (Beihang University, China)</i>	
A Rolling Bearing Fault Early Warning and Diagnosis Technology Based on Spectrum Analysis and Improved MSET	6
<i>Yazhou Li (Beihang University, China), Wei Dai (Beihang University, China), and Xi Han (Beijing System Design Institute of the Electro-mechanic Engineering, China)</i>	
State of Health Estimation of Lithium Ion Battery with Uncertainty Quantification Based on Bayesian Deep Learning	12
<i>Yuqi Ke (Sun Yat-sen University, China; Guangdong Provincial Key Laboratory of Fire Science and Technology, China), Ruomei Zhou (Sun Yat-sen University, China; Guangdong Provincial Key Laboratory of Fire Science and Technology, China), Rong Zhu (Sun Yat-sen University, China; Guangdong Provincial Key Laboratory of Fire Science and Technology, China), and Weiwen Peng (Sun Yat-sen University, China; Guangdong Provincial Key Laboratory of Fire Science and Technology, China)</i>	
Reliability Evaluation Method of Centrifugal Compressor Based on Rotor Vibration Signal Monitoring	19
<i>Yinghua Shao (Beihang University, China), Rui Kang (Beihang University, China), Ruiyang Li (Beihang University, China), and Jie Liu (Beihang University, China)</i>	

Performance-Based Reliability Prediction of Power Supply Considering Degradation Uncertainties	26
<i>Hao Niu (No.5 Electronics Research Institute of Ministry of Industry and Information Technology (MIIT), China), Shaohua Yang (No.5 Electronics Research Institute of Ministry of Industry and Information Technology (MIIT), China), Wenyuan Liao (No.5 Electronics Research Institute of Ministry of Industry and Information Technology (MIIT), China), Canxiong Lai (No.5 Electronics Research Institute of Ministry of Industry and Information Technology (MIIT), China), and Wen Sun (Shanghai Institute of Technical Physics, China)</i>	
Degradation Reliability Modeling for Nonlinearly Recoverable Products Under Random Shock	32
<i>Min Li (Beihang University, China), Zhihua Wang (Beihang University, China), Jie Ren (Beihang University, China), and Bo Wu (Beihang University, China)</i>	
Research on Fatigue Crack Growth Model of Aircraft Structural Parts Under Salt Spray	38
<i>Chao Song (China aero poly-technology establishment, China), Zhi Bian (laboratory of quality infrastructure efficacy research, China), Zhe Zhang (laboratory of quality infrastructure efficacy research, China), and Shunan Ding (beihang university, China)</i>	
Belief Reliability Modeling for a System with Degradation Interaction Effect	44
<i>Hao Li (Beihang University, China), Fangyou Fu (China Academy of Launch Vehicle Technology, China), and Fuqiang Sun (Beihang University, China)</i>	
Fault Prediction for Rotating Bearing United Genetic Algorithm Optimize Variational Mode Decomposition and Support Vector Machine	50
<i>Zijian Guo (Harbin Institute of Technology, China), Xuerong Ye (Harbin Institute of Technology, China), Jun Tan (Harbin Institute of Technology, China), and Guofu Zhai (Harbin Institute of Technology, China)</i>	
Application and Analysis of Prognostics and Health Management Technology in Weapon Equipment	56
<i>Bo Lang (China North Industries Group Corporation Limited, Aviation Ammunition Institute, China), Hongyu Zhao (China North Industries Group Corporation Limited, Aviation Ammunition Institute, China), Changwei Mi (China North Industries Group Corporation Limited, Aviation Ammunition Institute, China), Qiang Huang (China North Industries Group Corporation Limited, Aviation Ammunition Institute, China), Lijie Song (China North Industries Group Corporation Limited, Aviation Ammunition Institute, China), and Guoqiang Ma (China North Industries Group Corporation Limited, Aviation Ammunition Institute, China)</i>	
Uncertainty and Cost Based Robust Design Approach for Quality Consistency of Electromagnetic Actuators	60
<i>Jie Deng (Harbin Institute of Technology, China), Xiaohan Liu (Harbin Institute of Technology, China), and Guofu Zhai (Harbin Institute of Technology, China)</i>	

Reliability Research of GaN-Based Blue Semiconductor Lasers	67
<i>Chengwei Zhang (Changchun University of Science and Technology, China; The No.5 Electronics Research Institute of the Ministry of Industry and Information Technology, China), Wenyuan Liao (The No.5 Electronics Research Institute of the Ministry of Industry and Information Technology, China), Shaohua Yang (The No.5 Electronics Research Institute of the Ministry of Industry and Information Technology, China), Hongran Wang (Changchun University of Science and Technology, China; The No.5 Electronics Research Institute of the Ministry of Industry and Information Technology, China), Zhipeng Wei (Changchun University of Science and Technology, China), and Guoguang Lu (The No.5 Electronics Research Institute of the Ministry of Industry and Information Technology, China)</i>	
Research on Failure Mechanism of 976nm Tapered Laser	73
<i>Hongran Wang (Changchun University of Science and Technology, China; The No.5 Electronics Research Institute of the Ministry of Industry and Information Technology, China), Wenyuan Liao (The No.5 Electronics Research Institute of the Ministry of Industry and Information Technology, China), Shaohua Yang (The No.5 Electronics Research Institute of the Ministry of Industry and Information Technology, China), Chengwei Zhang (Changchun University of Science and Technology, China; The No.5 Electronics Research Institute of the Ministry of Industry and Information Technology, China), Guoguang Lu (The No.5 Electronics Research Institute of the Ministry of Industry and Information Technology, China), Zhipeng Wei (Changchun University of Science and Technology, China), and Xiaohua Wang (Changchun University of Science and Technology, China)</i>	
Determination of Key Components and Failure Mechanism Analysis of Smart Electricity Meter	78
<i>Wenwen Li (State Grid Jibei Electric Power Co., Ltd, China), Ruiming Yuan (State Grid Jibei Electric Power Co., China), Jiao Guo (State Grid Jibei Electric Power Co., Ltd, China), Haoxiang Li (Harbin Institute of Technology, China), and Xuerong Ye (Harbin Institute of Technology, China)</i>	
An Efficient Robust Design Optimization Approach of Electromagnetic Relay Based on Surrogate Model and Evolutionary Algorithm	83
<i>Hao Chen (Harbin Institute of Technology, China), Xuerong Ye (Harbin Institute of Technology, China), Yigang Lin (Wenzhou University, China), and Guofu Zhai (Harbin Institute of Technology, China)</i>	
Feature Engineering Study for Signal Identification of Sealed Relay Components	88
<i>Yaoyang Wu (Heilongjiang University, China), Guotao Wang (Heilongjiang University, China), Bingze Lv (Heilongjiang University, China), Yongyue Xue (Heilongjiang University, China), and Yuru Teng (Heilongjiang University, China)</i>	
Contact Bounce Model Considering Arc Ignition for Relay Contact Reliability Evaluation	94
<i>Lanxiang Liu (Harbin Institute of Technology, China), Wenyong Yang (Harbin Institute of Technology, China), Li Chen (Huabei Oil Communication Co.Ltd., China), and Guofu Zhai (Harbin Institute of Technology, China)</i>	

Analysis of Internal Atmosphere of InGaAs Detectors with Different Degassing Conditions	99
<i>Canxiong Lai (CEPREI, China), Wen Sun (Key Laboratory of Infrared Imaging Materials and Detectors, Shanghai Institute of Technical Physics, China), Shaohua Yang (CEPREI, China), and Bin Zhou (CEPREI, China)</i>	
Optimized Design for Noise Reduction Considering Relay Reliability	103
<i>Wenyong Yang (Reliability Institute for Electric Apparatus and Electronics Harbin Institute of Technology, China) and Xuan Jia (Reliability Institute for Electric Apparatus and Electronics Harbin Institute of Technology, China)</i>	
Research on Phase Consistency of Optical Fiber Delay Module	108
<i>Wenyuan Liao (China Electronic Product Reliability and Environmental Testing Research Institute, China) and Shuwang Li (China Electronic Product Reliability and Environmental Testing Research Institute, China)</i>	
Sensitivity-Analysis-Based Reliability Enhancement for Networked Control Systems	113
<i>Ying Gao (Beihang University, China), Qiang Dong (Beihang University, China), Mo Tao (Science and Technology on Thermal Energy and Power Laboratory, China; Wuhan Second Ship Design and Research Institute, China), Wei Zheng (Science and Technology on Thermal Energy and Power Laboratory, China; Wuhan Second Ship Design and Research Institute, China), Zhiwu Ke (Science and Technology on Thermal Energy and Power Laboratory, China; Wuhan Second Ship Design and Research Institute, China), and Yi Feng (Science and Technology on Thermal Energy and Power Laboratory, China; Wuhan Second Ship Design and Research Institute, China)</i>	
Research on Protection System of Electronic On-Load Tap-Changers Based Sen Transformer	118
<i>Yuhang Pan (Institute of Reliability in Electrical Apparatus and Electronics, Harbin Institute of Technology, China) and Wenyong Yang (Institute of Reliability in Electrical Apparatus and Electronics, Harbin Institute of Technology, China)</i>	
Simulation Analysis Evaluation of Support Capability for Unmanned Aircraft Systems	125
<i>Yun Wang (China Academy of Aerospace Standardization and Product Assurance, P.R.China), Yingchun Ran (China Academy of Aerospace Standardization and Product Assurance, P.R.China), Pengwei Hu (China Academy of Aerospace Standardization and Product Assurance, P.R.China), Hailong Cheng (China Academy of Aerospace Standardization and Product Assurance, P.R.China), and Tie Li (Shanghai Electro-Mechanical Engineering Institute, P.R. China)</i>	
Model-Based Quality Consistency Analysis of Permanent Magnet Synchronous Motor Cogging Torque in Wide Temperature Range	131
<i>Cen Chen (Harbin Institute of Technology, China), Chengzhi Sun (Harbin Institute of Technology, China), Liqin Wu (Harbin Institute of Technology, China), Xuerong Ye (Harbin Institute of Technology, China), and Guofu Zhai (Harbin Institute of Technology, China)</i>	

Estimation of Lithium Primary Battery Capacity Based on Pulse Load Test	139
<i>Qisen Sun (Harbin Institute of Technology, China), Xuerong Ye (Harbin Institute of Technology, China), Haoxiang Li (Harbin Institute of Technology, China), Wenwen Li (State Grid Jibei Electric Power Co., Ltd, China), Ruiming Yuan (State Grid Jibei Electric Power Co., Ltd, China), and Guofu Zhai (Harbin Institute of Technology, China)</i>	
Providing the Required Probability of Synchronization Error when Splitting a Fiber-Optic Line into Sections with Decreasing Length in a Quantum Key Distribution System	145
<i>Yakov Mironov (Southern Federal University, Russia) and Konstantin Rumyantsev (Southern Federal University, Russia)</i>	
An Improved Solution for Degradation-Shock Dependence Models Considering a Specific Shock Load Level	150
<i>Shihao Cao (BeiHang University, China), Zhihua Wang (BeiHang University, China), Ao Zhang (BeiHang University, China), and Xiangshun Ma (BeiHang University, China)</i>	
Study on Accelerate Storage Test and Lifetime Evaluation of Sensors	156
<i>Jinping Li (The 49th Research Institute of China Electronics, Technology Group Corporation, China) and Linghui Wu (The 49th Research Institute of China Electronics, Technology Group Corporation, China)</i>	
Life Prediction of Electromagnetic Relay Based on GRU-1dCNN	161
<i>Baixin Liu (Jiangsu University of Science and Technology, China), Zhaobin Wang (Jiangsu University of Science and Technology, China), Zhen Li (Jiangsu University of Science and Technology, China), and Qingyun Qiao (Jiangsu University of Science and Technology, China)</i>	
Reliability Evaluation Method of Aerospace Relays Based on Fusion of Simulation Data and Small Sample Test Data	167
<i>Qingshen Li (Wenzhou university, China), Yigang Lin (Wenzhou university, China), Shanshan Wang (Wenzhou university, China), and Xiangou Zhu (Wenzhou university, China)</i>	
Life Prediction of Lithium Thionyl Chloride Battery Based on Pulse Load Test and Accelerated Degradation Test	174
<i>Qisen Sun (Harbin Institute of Technology, China), Xuerong Ye (Harbin Institute of Technology, China), Haoxiang Li (Harbin Institute of Technology, China), Wenwen Li (State Grid Jibei Electric Power Co., Ltd, China), Ruiming Yuan (State Grid Jibei Electric Power Co., Ltd, China), and Guofu Zhai (Harbin Institute of Technology, China)</i>	
Optimal Design of Multi-Stress Accelerated Degradation Tests Based on Bootstrap Method	181
<i>Gen Liu (Beihang University, China), Zhihua Wang (Beihang University, China), Gongcheng Shi (Beihang University, China), and Lu Li (Beihang University, China)</i>	
Accelerated Aging Test and Life Prediction of Rubber Strip for Connector Sealing	187
<i>Xu Le (Harbin Institute of Technology, China), Hu Ke (Harbin Institute of Technology, China), Chen Dongxu (Harbin Institute of Technology, China), and Zhai Guofu (Harbin Institute of Technology, China)</i>	
An Uncertain Statistics of Uncertain Accelerated Degradation Model Based on the Method of Moments	192
<i>Zhao Tao (Beihang University, China), Xiao-Yang Li (Beihang University, China), and Wen-Bin Chen (Beihang University, China)</i>	

Aging-Intensity-Based Model Selection and Parameter Estimation on Heavily Censored Data	199
<i>Renyan Jiang (Changsha University of Science and Technology, China)</i>	
Reliability Calculation Method Based on General Data of Small Sample Equipment in Launch Site	206
<i>Jian Huang (State Key Laboratory of Aerospace Dynamics, China), Chen Hu Liu (State Key Laboratory of Aerospace Dynamics, China), Ning Zhao (State Key Laboratory of Aerospace Dynamics, China), Yang Song Yi Su (State Key Laboratory of Aerospace Dynamics, China), and Yi Gao (State Key Laboratory of Aerospace Dynamics, China)</i>	
Optimal Operating Reserve Scheduling for Power System with Reliability and Wind Curtailment Limits	211
<i>Yang Yang (Industrial Systems Engineering and Management, National University of Singapore, Singapore) and Loon Ching Tang (Industrial Systems Engineering and Management, National University of Singapore, Singapore)</i>	
Reliability Optimization Deployment of Complex Electromechanical Equipment Based on Multi-Objective Optimization Algorithm	217
<i>Deng Jianhui (PLA 92942, China), Liu Yanyan (University of Science and Technology Beijing, China), Liu Pengpeng (PLA 92942, China), and Huang Jine (PLA 92942, China)</i>	
Reliability Allocation Method of Comprehensive Weight Computer Numerical Control Machine Tool Based on Failure Correlation and Factor Correlation	222
<i>Gu Dongwei (Changchun University of Technology, China), Xu Zhen (Changchun University of Technology, China), Zhong Yuhong (Changchun University of Technology, China), Li Qihan (Changchun University of Technology, China), and Long Zhe (Changchun University of Technology, China)</i>	
A Data-Driven Pricing Model for Extended Warranty Under Different Product Failures and Customer Characteristics	230
<i>Jiaxiang Cai (National University of Singapore, Singapore), Xin Wang (Shanghai Jiao Tong University, China), and Zhisheng Ye (National University of Singapore, Singapore)</i>	
Simulation Study on Production Decision of Order-Type Enterprise Based on Service Reliability	237
<i>Wei Wang (Beihang University, PR China) and Chenxi Li (Beihang University, PR China)</i>	
Optimal Periodic Switching Strategy For a Two-Unit Warm Standby Degradation System	242
<i>Senyang Bai (National University of Defense Technology, China), Xiang Jia (National University of Defense Technology, China), Zhijun Cheng (National University of Defense Technology, China), Bo Guo (National University of Defense Technology, China), and Qian Zhao (National University of Defense Technology, China)</i>	
Deep Reinforcement Learning Based Microgrid Expansion Planning with Battery Degradation and Resilience Enhancement	251
<i>Kexin Pang (Nanjing University of Science and Technology, China), Jian Zhou (Nanjing University of Science and Technology, China), Stamatis Tsianikas (Rutgers University, USA), and Yizhong Ma (Nanjing University of Science and Technology, China)</i>	

Component Selections for Preventive Maintenance with Cost Maintenance Priority	258
<i>Wenjun Zhang (Wuhan Second Ship Design & Research Institute, P.R. China), Yong Yang (Shanghai marine equipment research and institute, P.R. China), Bei Xu (National University of Defense Technology, China; Nanchang HangKong University, P.R. China), and Junyong Tao (National University of Defense Technology, P.R. China)</i>	
Imperfect Maintenance Optimization of Multi-State Rolling Stocks Based on Deep Reinforcement Learning	265
<i>Chen Zhang (Tsinghua University, China) and Yan-Fu Li (Tsinghua University, China)</i>	
Topology Optimization of District Heating Network Based on Edge Influence Degree	270
<i>Ding Mao (Harbin Institute of Technology, China; Key Laboratory of Cold Region Urban and Rural Human Settlement Environment Science and Technology, China), Peng Wang (Harbin Institute of Technology, China; Key Laboratory of Cold Region Urban and Rural Human Settlement Environment Science and Technology, China), and Long Ni (Harbin Institute of Technology, China; Key Laboratory of Cold Region Urban and Rural Human Settlement Environment Science and Technology, China)</i>	
Statistical Modeling and Inference of the Effectiveness of Preventive Maintenance for Repairable Systems	278
<i>Xin Ye (National University of Singapore, Singapore), Jiexiang Cai (National University of Singapore, Singapore), and Loon Ching Tang (National University of Singapore, Singapore)</i>	
Research on Intelligent Fire Identification Technology of Typical Cabin of SHIP	283
<i>Zichen Zhou (Marine Design & Research Institute of China(MARIC), China), Shiyang Wang (Marine Design & Research Institute of China(MARIC), China), Haisong Xiao (Marine Design & Research Institute of China(MARIC), China), and Liang Hong (Marine Design & Research Institute of China(MARIC), China)</i>	
A Hybrid Compute Engine Implemented for Dynamic Reliability and Risk Analysis	290
<i>Jun Yang (South China University of Technology, China), Fengjun Li (China Nuclear Power Engineering Company Ltd, China), Chenyu Jiang (South China University of Technology, China), Licheng Zheng (South China University of Technology, China), Yuerui Deng (South China University of Technology, China), Jieheng Liang (South China University of Technology, China), and Ming Yang (Shenzhen University, China)</i>	
Research on Risk Prediction of Major Hazards Installation Enterprises Based on Random Forest	301
<i>Jing-cong Zhu (China Academy of Safety Science and Technology, China), Dong Meng (China Academy of Safety Science and Technology, China), Ying Zhao (China Academy of Safety Science and Technology, China), and Lei Guan (China Academy of Safety Science and Technology, China)</i>	
Research on Distribution Field Reconstruction Technology Based on Markov Random Field-Kriging Model	306
<i>Yuhao Zha (Beihang University, China), Jun Yang (Beihang University, China), and Huiling Zheng (Beihang University, China)</i>	

Evolution Mechanism of Mission Safety Based on SST	312
<i>Jihui Xu (Air Force Engineering University, China), Yujin Chen (Air Force Engineering University, China), Jing Zhang (Air Force Engineering University, China), and Qirong Chen (Air Force Engineering University, China)</i>	
Research on the Evaluation and Prediction Method of Solar-Powered UAV Energy and Electrical System Health State Based on DBN	318
<i>Zhexuan Sun (Beihang University, China), Lizhi Wang (Beihang University, Unmanned System Institute, China), and Xiaohong Wang (Beihang University, China)</i>	
Evaluation on the Readiness Ratio and Mission Reliability of Intelligent Ships Based on the Integrated PHM System Design	323
<i>Xiangxiang Zhang (Marine Design & Research Institute of China, China), Shiyang Wang (Marine Design & Research Institute of China, China), Baoqing Wang (Marine Design & Research Institute of China, China), and Haowen Chen (Marine Design & Research Institute of China, China)</i>	
Time-Dependent Reliability Analysis of System Based on Dynamic Bayesian Fault Network	331
<i>Yunwen Feng (Northwestern Polytechnical University, China), Zhicen Song (Northwestern Polytechnical University, China), Cheng Lu (Northwestern Polytechnical University, China), and Chuxiong Yin (COMAC Shanghai Aircraft customer Service CO., Ltd., China)</i>	
Reliability Analysis of Instrument Power System Based on Monte Carlo-Dynamic Fault Tree	337
<i>Sipei Chen (State Nuclear Electric Power Planning Design & Research Institute Co. LTD, China), Lili Wang (State Nuclear Electric Power Planning Design & Research Institute Co. LTD, China), Zhenhua Wei (State Nuclear Electric Power Planning Design & Research Institute Co. LTD, China), and Xingyu Qiao (North China Electric Power University, China)</i>	
Research On Simulation Trade-off Analysis Method of Reliability Index of Component-Based Software	343
<i>Lihao Yang (CEPREI, China), Jingbo Liu (Beijing Institute of Special Electromechanical Technology, China), Hongqi Yang (CEPREI, China), Guojian Nie (CEPREI, China), Ning Hu (CEPREI, China), and Xiangwei Wu (CEPREI, China)</i>	
Reliability Evaluation of Phased Mission System Under Multiple Correlated Failure Modes	349
<i>Xuejiao Du (Harbin Engineering University, China), Caihong Zhou (Harbin Engineering University, China), Jingbo Gai (Harbin Engineering University, China), and Ke Yan</i>	
Research on Modeling in Operator Mental Workload Based on VACP Method	359
<i>Hanguan Wen (South China University of Technology, China), Ming Yang (Shenzhen University, China), Jieheng Liang (South China University of Technology, China), and Zhihui Xu (State Key Laboratory of Nuclear Power Safety Monitoring Technology and Equipment, China)</i>	
Bayesian Information Fusion for Imprecise Probabilistic Models with Different Types of Information	363
<i>Chenxing Wang (University of Science and Technology Beijing, China), Lechang Yang (University of Science and Technology Beijing, China), and Roberto Rocchetta (Technical University of Eindhoven, Netherlands)</i>	

Author Index 369