QR2MSE 2022

The 12th International Conference on

Quality, Reliability, Risk, Maintenance, and Safety Engineering

July 27-30, 2022, Emeishan, Sichuan, China

Sponsored by

- IEEE Chengdu Section
- Reliability Committee of Operations Research Society of China
- Center for System Reliability and Safety, UESTC

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- European Safety and Reliability Association
- International Society of Engineering Asset Management













QR2MSE 2022

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I. Welcome



Professor Hong-Zhong Huang

General Chair of QR2MSE 2022 Director of Center for System Reliability and Safety University of Electronic Science and Technology of China No. 2006, Xiyuan Avenue, West Hi-Tech Zone Chengdu, Sichuan, 611731, P. R. China

On behalf of the Organizing Committee, I would like to welcome you to the 12th International Conference on Quality, Reliability, Risk, Maintenance, and Safety Engineering (QR2MSE 2022), in Emeishan, Sichuan, China from July 27-30, 2022. First of all, I hope all colleagues and friends around the world are healthy and safe.

Twelve years have flown by, and we meet again! The annual QR2MSE conference is designed to provide a premier international forum where leading experts and engineers with diverse backgrounds and experience in quality, reliability, risk, maintenance, and safety engineering can share their latest ideas, cutting-edge research, methods, and tools with their peers. Thanks to the active support of all colleagues and friends, the event grew rapidly and became the most prestigious event in the reliability community, and we are very pleased with the successful career development of many young researchers. We still remember that the QR2MSE conference was held nine years ago in Emeishan, Sichuan, China. Nine years later, we are gathered again in Emeishan to celebrate the 12th QR2MSE.

455 papers have been submitted to the conference, and 211 papers have been selected and included in this year's conference proceedings. The conference program includes 8 keynote lectures by world-renowned scholars and 8 regular technical paper oral sessions. It provides great opportunities to exchange academic ideas and strengthen professional networks.

A successful conference depends on many dedicated individuals who serve as conference chairs, members of the advisory committee, program committee, organizing committee, and secretariat, as well as many participants and volunteers. The support of the following societies, institutions, and groups is also greatly appreciated: IEEE Chengdu Section, Reliability Committee of Operations Research Society of China, Center for System Reliability and Safety, UESTC, Bernoulli Society for Mathematical Statistics and Probability, The Korean Reliability Society (KORAS), Reliability Engineering Association of Japan (REAJ), Korean Society for Prognostics and Health Management, Reliability Division of the Korean Society of Mechanical Engineers (KSME), European Safety and Reliability Association (ESRA), International Society of Engineering Asset Management (ISEAM), Tsinghua University, Inner Mongolia University of Technology, Dalian Maritime University, Beijing University of Technology, University of Electronic Science and Technology of China, Taiyuan Heavy Machinery Group Co., Ltd, State Key Laboratory of Mining Equipment and Intelligent Manufacturing, The State Key Laboratory of Mechanical Transmissions, Wenzhou University, Dalian Jiaotong University, Changsha University of Science & Technology, Jiangxi University of Science and Technology, Chongging University of Science and Technology, Sanming University, Southwest Jiaotong University, Qinda Technology Co., Ltd., Chengdu Chuangpin Robot Research Center (Limited Partnership) Co., Ltd.

I am confident that this conference will meet your highest expectations. I sincerely hope that you will have a wonderful experience in Emeishan, and look forward to your participation in our future conferences.



II. QR2MSE 2022 Organizing Committee

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EMEISHAN, SICHUAN, CHINA JULY, 27-30, 2022

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- Korean Society for Prognostics and Health Management
- Reliability Division of the Korean Society of Mechanical Engineers



- European Safety and Reliability Association
- International Society of Engineering Asset Management



IV. Keynote Speeches

A. Keynote Speech 1



Thursday, July 28 / 09:00-09:40, Grand Banquet Hall

Title: Key Technologies for Reliability Evaluation of Industrial Robots

Xu Han, PhD, Professor, President Hebei University of Technology

Tianjin, China

Abstract: In recent years, the technologies and intelligence level in the field of industrial robots have been greatly improved, and owing to the development of robot body, system integration and production of key components, the domestic substitution rate has also been continuously increased. In particular, the requirements of high reliability, long life, and high performance have brought new challenges to the performance testing, evaluation technology, and the performance of the testing equipment. Due to the characteristics of multi-environment stress coupling and the dynamic multi-variable in the service conditions of industrial robots, how to achieve the fast and effective testing and accurate performance evaluation, develop high-performance professional testing equipment have become the bottleneck problem. This report will introduce the reliability acceleration test technology and the corresponding test equipment driven by the real service conditions, the motion accuracy testing and improving technology, the reliability prediction and optimization technology for industrial robots. A comparison with the cutting-edge achievements in this field is also conducted to show the importance and advantages of the proposed technical method.

Speaker Bio: Professor Xu Han has specialized principally in reliability analysis, advanced design theory and method of complex equipment based on numerical simulation, etc. He has contributed greatly to high performance engineering optimization design theory and method system, and developed the non-probabilistic reliability modeling and design of the theoretical framework. Prof. Han's related theory achievement has been successfully applied to manufacturing equipment, vehicle engineering, engineering machinery, and other fields. Prof. Han serves as the associate editors for ASME Journal of Mechanical Design, Inverse Problems in Science & Engineering and International Journal of Computational Methods. He is the author of 4 monographs and has published more than 200 peer-reviewed papers with over 10,000 citations, and has been named as a Highly Cited Chinese Researcher of Mechanical Engineering in the years of 2014 to 2021. Prof. Han has received numerous awards including the Second Prize of National Science and Technology Progress Award, First Prize of Technology Invention Award of China Machinery Industry Federation, Science and Technology Outstanding Contribution Award of Hebei Province.



B. Keynote Speech 2



Thursday, July 28 / 09:40-10:20, Grand Banquet Hall

Title: Resilience analysis of complex systems with multi-mechanism coupling

Shubin Si, PhD, Professor Northwestern Polytechnical University Xi'an, China

Abstract: We first introduce the general definition, multidisciplinary and general analysis framework of system resilience. Then, this research propose a resilience analysis method for the high-dimensional complex networks with multi-mechanism coupling. The alternative stable states, abrupt phase shifts and tipping points, critical slowing down and other law phenomena of complex systems are also described in detail. Finally, the cases of ecological network, gene regulation network, social network, financial risk network and liver function network are discussed to show the application methods of the multi-mechanism coupling theory of complex system resilience models.

Speaker Bio: Dr. Shubin Si is a professor in the Department of Industrial Engineering at Northwestern Polytechnical University (NPU), Xi'an, China. He received his Ph.D. degree in Management Science and Engineering from NPU in 2006. His research interests include resilience and reliability analysis for complex systems. Now he has published more than 90 research papers in international journals such as *PNAS*, *Frontiers of Engineering Management*, *IISE Transactions, IEEE Transactions on Reliability, Reliability Engineering and System Safety*, etc. He is an Associate Editor for *IEEE Transactions on Reliability*, a vice Chairman of Reliability Committee of Operation Research Society of China and a Vice Chairman of Industrial Engineering Committee of Chinese Society of Optimization. He is also a senior Member of IISE and a senior Member of IEEE.



C. Keynote Speech 3



Thursday, July 28 / 10:40-11:20, Grand Banquet Hall

Title: Key Technology of Large Hoisting Equipment for AnnualOutput of 10 Million Tons Coal Mine

Zhencai Zhu, PhD, Professor, Vice President of CCMS China University of Mining and Technology Xuzhou, China

Abstract: Shaft hoisting is the main way to transport raw coal, equipment and personnel in mines. With the increasing demand for coal, the annual generation capacity of large-scale shaft in China has reached 10 million tons, and the mining depth has reached more than 1,000 meters, which puts forward higher requirements for efficient coal mining technology and supporting equipment. This report will first introduce the key technologies of large-scale hoisting equipment with a well depth of less than 1000m, including the key technologies of large-scale hoists, large-scale hoisting containers and the safe operation guarantee technologies of hoisting systems. Then, it introduces the problems existing in large-scale hoisting equipment with well depth of 1500-2000m at present, compares the design differences of single-rope winding, double-rope winding and multi-rope winding hoists, and focuses on the design points and application prospect of double-rope winding hoists.

Speaker Bio: Prof. ZHU has long been engaged in the research of mine hoisting transportation technology and equipment. He has presided over the National Key Research and Development Program, National Basic Research Program of China (973 Program), National High-tech R&D Program (863 Program) and Key Project of National Natural Science Foundation of China. He has hold 52 international invention patents and 55 Chinese invention patents as the first inventor. His research achievements have won two second prize of National Technology Invention Award (Ranked 1 and 2), two second prize of National Science and Technology Progress Award (Ranked 1), four first prize of Jiangsu Provincial Science and Technology Award (Ranked 1), and two first prize of Science and Technology Progress of Ministry of Education (Ranked 1 and 2). He is an expert enjoying the Special Government Allowance of the State Council and selected as the National Candidates of Millions of Talents Project in the New Century. He has won the National Outstanding Scientific and Technology Award, National Outstanding Engineer Award, Sun Yueqi Energy Award, and Chief Scientist of "333 Talent Project" in Jiangsu province.



D. Keynote Speech 4



Thursday, July 28 / 11:20-12:00, Grand Banquet Hall

Title:Data-driven Remaining Useful Life Prediction Techniquesfor Stochastic Degrading Systems

Xiaosheng Si, PhD, Professor Rocket Force University of Engineering

Xi'an, China

Abstract: Stochastic degradation data analysis is the basic and core component to implement life prognosis and health management of complex engineering systems. Extensive studies on this subject have been witnessed in the fields of reliability and system engineering. This report will be focused on challenging and fundamental problems in data modeling and model solution for the remaining useful life prediction of stochastic degrading systems. The emphasis will be placed on techniques dealing with linear models, nonlinear model, and switching models. Finally, the future directions will be discussed.

Speaker Bio: Xiaosheng Si received the B. Eng., M. Eng., and Ph.D. degrees from the Department of Automation, Rocket Force University of Engineering, Xi'an, China, in 2006, 2009, and 2014, respectively, all in control science and engineering. He is currently a Professor in Zhijian Laboratory with the Rocket Force University of Engineering. He has authored or co-authored more than 70 articles in several journals including European Journal of Operational Research, IEEE Transactions on Industrial Electronics, IEEE Transactions on Reliability, IEEE Transactions on Fuzzy Systems, IEEE Transactions on Systems, Man and Cybernetics: Systems, IEEE Transaction on Automation Science and Engineering, Reliability Engineering and System Safety, and Mechanical Systems and Signal Processing. He is an active reviewer for a number of international journals. His research interests include evidence theory, expert system, prognostics and health management, reliability estimation, predictive maintenance, and lifetime estimation. Dr. SI is an Editorial Member of Mechanical Systems and Signal Processing and IEEE ACCESS.



E. Keynote Speech 5



Friday July 29 / 08:30-09:10, Grand Banquet Hall

Title: Reliability methods – from theory to application

Liyang Xie, PhD, Professor Northeastern University Shenyang, China

Abstract: Concerned by the reliability analyses in engineering are events with very small occurring probability described through the left tail of a life probability density function curve, while the random events that the classical probability theory can well analyzed is large probability ones described by the middle part of pdf curves. For parameter estimation, most of the methods work well for large size samples, while normally only small size samples are available for practical engineering problems. This lecture explains the demand of reliability engineering for probability and statistics theory and method, highlights the gap between reliability theory and engineering application, discusses potential ways to resolve reliability analysis and probability estimation problems in engineering.

Speaker Bio: Prof. Liyang Xie is a professor at Northeastern University, Shenyang, China. He received his BS (1982) in mechanical Manufacturing, MS (1985) & PhD (1988) in structural integrity from Northeastern University, Shenyang, China. He worked one year in the Probabilistic Safety Analysis Institute, TUVE Nord, Hamburg, Germany in 1996 and two more years in the Department of Plant Safety, Otto-von-Guericke University, Magdeburg, Germany during 1997-1998. His research interests include structural integrity, reliability and system probabilistic risk analysis. He has published more than 100 research papers in peer reviewed journals and six books. He is editorial board member of Int. J. of Reliability and Safety, Int. J. of Advances in Reliability and Engineering Failure Analysis. He is the Vice Chairman of Fatigue Branch of Chinese Materials Research Society, Vice Chairman of Reliability branch of Chinese society of Mechanical Engineering.



F. Keynote Speech 6



Friday, July 29 / 09:10-09:50, Grand Banquet Hall

Title: Terahertz Nondestructive Testing and Quantitative Evaluation

Shuncong Zhong, PhD, Chair Professor

Fuzhou University

Fuzhou, China

Abstract: Terahertz (THz) waves, whose frequencies range between microwave and infrared, are part of the electromagnetic spectrum. A gap exists in THz literature because investigating THz waves is difficult due to the weak characteristics of the waves and the lack of suitable THz sources and detectors. Recently, THz nondestructive testing (NDT) technology has become an interesting topic. This presentation will outline several typical THz devices and systems and engineering applications of THz NDT techniques in composite materials, thermal barrier coatings, car paint films, marine protective coatings, and pharmaceutical tablet coatings. THz will be compared with the other existing NDT techniques such as ultrasound imaging, optical coherence tomography etc. The talk will present the significance and advantages provided by the emerging THz NDT technique.

Speaker Bio: Prof. ZHONG got his PhD degree from The University of Manchester, United Kingdom, in 2007. He had many-year industrial and academic career in Imperial College London, University of Liverpool, University of Strathclyde, Shanghai Jiaotong University, and Mindray Co., Ltd. His research interests are on optical and terahertz instrumentations, non-destructive testing & evaluation, intelligent sensing and diagnosis, signal and image processing, and pattern recognition for diagnosis and prognostics. He has hold more than 65 Chinese patents and has published 3 book/chapters, 1 ISO standard and more than 200 journal papers in Angewandte, Nanophotonics, Nanoscale, Mechanical Systems and Signal Processing, Structural Control and Health Monitoring, etc. He received First Prize of Fujian Provincial Science and Technology Award, and National middle-aged and young experts with outstanding contributions in 2020. He was elected as a Fellow of the Institution of Engineering and Technology and a Fellow of International Society for Condition Monitoring in 2018 and 2020 respectively.



G. Keynote Speech 7



Friday, July 29 / 10:20-11:00, Grand Banquet Hall

Title:Progress in Creep-Fatigue Life Design forHigh-Temperature Structures

Xian-Cheng Zhang, PhD, Professor East China University of Science and Technology Shanghai, China

Abstract: Many key-section components in aero-engines, gas turbines, pressure vessels and pipelines at elevated temperatures are always subjected to creep-fatigue loads. Therefore, the development of a high-precision creep-fatigue life design method based on failure physics has important engineering significance and far-reaching practical implications. The report demonstrates the research progress in four aspects: mesoscopic-macroscopic, air-environment, uniaxial-multiaxial and deterministic-probabilistic. The above research progress has achieved the initial leap from "empirical" to "physical", which is of certain theoretical value to enrich the high-temperature strength theory based on failure physics, and also lays the scientific foundation for the future reliability operation and maintenance integrating digital twinning.

Speaker Bio: Dr. Zhang has been working on the fundamental research and technical assistance to guarantee the long-term and high-reliability operations of the components at high/low-temperature harsh environments. His main academic achievements can be reflected in the following three aspects, namely establishing life design methods on the basis of damage mechanics approach, proposing life assessment methods on the basis of multi-scale fracture mechanics, and developing life improvement technologies on the basis of surface integrity regulations. He has obtained the Second Prize in China's State Natural Science Award, Henry Granjon Prize of International Institute of Welding, China Youth Science and Technology Award. He has been selected into the National Science Fund for Distinguished Young Scholars, and the National Defense Science and Technology Fund for Excellence Young Scholars. He has served as associate editor or editorial board member of 10 journals. He is the director of Key Laboratories of the Ministry of Education, the director of collaborative innovation center for Aeroengine Life Prediction of AECC Commercial Aircraft Engine Co., Ltd, and the director of Collaborative Innovation Center for Structural Integrity of China United Gas Turbine Technology Co., Ltd.



H. Keynote Speech 8



Friday, July 29 / 11:00-11:40, Grand Banquet Hall

Title: An Overview of Regional Risk and Resilience Analysis

Paolo Gardoni, PhD, Professor, RESS Editor-in-Chief University of Illinois at Urbana-Champaign Illinois, USA

Abstract: Civil structures and infrastructure provide vital services that support and enable societal functions. Therefore, ensuring their reliability and prompt recovery is critical for the public's well-being and economic prosperity. The consequences of past disasters around the world have raised concerns about the vulnerability of civil structures and infrastructure and have highlighted the significance of risk mitigation and management. The maintenance, repair, or replacement of existing vulnerable, deficient, and deteriorating structures and infrastructure represents a significant investment. To wisely invest the limited funding, it is crucial to use advanced risk analysis tools in the decision-making process. This presentation discusses a general formulation for regional risk and resilience analysis. The presentation explains how to conduct a regional risk and resilience analysis considering multiple hazards and different infrastructure, as well as the effects of deterioration and interdependencies among infrastructure. Finally, the presentation concludes with the modeling of business interruption due to a hypothetical earthquake in the New Madrid seismic zone.

Speaker Bio: Paolo Gardoni is the Alfredo H. Ang Family Professor and an Excellence Faculty Scholar in the Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign. He is also a Professor in the Department of Biomedical and Translational Sciences in the Carle Illinois College of Medicine, and a Fellow of the Office of Risk Management & Insurance Research in the Gies College of Business. He is the Director of the Multi-hazard Approach to Engineering (MAE) Center, the Editor-in-Chief of the journal Reliability Engineering and System Safety, and the founder and former Editor-in-Chief of the journal Sustainable and Resilient Infrastructure. Prof. Gardoni is a member of the Board of Governors of the Engineering Mechanics Institute of the American Society of Civil Engineering, and of several national and international committees and associations on risk, reliability, and resilience analysis. His research interests include probabilistic mechanics; reliability, risk and life cycle analysis; decision-making under uncertainty; performance assessment of deteriorating systems; modeling of natural hazards and societal impact; ethical, social and legal dimensions of risk; optimal strategies for natural hazard mitigation and disaster recovery; and engineering ethics. Prof. Gardoni is the 2021 recipient of the prestigious Alfredo Ang Award on Risk Analysis and Management of Civil Infrastructure from the American Society of Civil Engineers. The award was given for his contributions to risk, reliability, and resilience analysis, and his leadership in these fields. He is the author of 1 book, 9 edited volumes, over 200 journal papers, and 28 book chapters; and has received over \$50 million in research funding.



V. Program Information

- A. Conference Topics
- I Reliability Modeling and Risk Analysis
- II Reliability, Maintainability, and Supportability
- III System Analysis, Simulation and Optimization
- IV Fault Diagnosis, Prognosis, Condition Monitoring and PHM
- V Robust, Reliability-Based, and Lifecycle Design
- VI Maintenance and Warranty Management
- VII Failure Physics, Material Science, Data Analysis, and Reliability Testing



B. Program at A Glance

Date Time	July 27 (Wednesday)	July 28 (Thursday)	July 29 (Friday)
		Opening Ceremony	Keynote Speech 5
		Keynote Speech 1	
08:30-12:00		Keynote Speech 2	Keynote Speech 6
		Tea Break	Tea Break
		Keynote Speech 3	Keynote Speech 7
		Keynote Speech 4	Keynote Speech 8
12:00-14:00		Lunch	Lunch
		Oral Session A	Oral Session C
14:00-18:00	Registration	Tea Break	Tea Break
		Oral Session B	Oral Session D
18:00	Dinner	Dinner	Banquet

8:30-12:00



C. Detailed Timetable

July 28 [Thursday]

Room **Grand Banguet Hall** Time 08:00-12:00 Registration 08:30-09:00 **Opening Ceremony** Chair: **Keynote Speech 1:** Prof. Hong-Zhong Huang Xu Han, PhD, Professor, President University of Electronic 09:00-09:40 Hebei University of Technology, China Science and Key Technologies for Reliability Evaluation of Technology of China, Industrial Robots China Chair: **Keynote Speech 2:** Prof. Bin Wu Shubin Si, PhD, Professor 09:40-10:20 Aero Engine Academy of Northwestern Polytechnical University, China China, **Resilience Analysis of Complex Systems with** China Multi-Mechanism Coupling 10:20-10:40 Tea Break **Keynote Speech 3:** Chair: Zhencai Zhu, PhD, Professor, Vice President of CCMS Prof. Hongming Zhou 10:40-11:20 China University of Mining and Technology, China Wenzhou University, Key Technology of Large Hoisting Equipment for China Annual Output of 10 Million Tons Coal Mine Keynote Speech 4: Chair: Xiaosheng Si, PhD, Professor Prof. Yan-Fu Li Zhijian Laboratory, Rocket Force University of 11:20-12:00 Tsinghua University, Engineering, China China **Data-driven Remaining Useful Life Prediction Techniques for Stochastic Degrading Systems** 12:00-14:00 Lunch



July 28 [Thursday] 14:00-16:10

Time	Room	Conference Room 1	Conference Room 3	Conference Room 4	Conference Room 7
Conference Topic		Reliability Modeling and Risk Analysis (I)	Reliability Modeling and Risk Analysis (I)	System Analysis, Simulation and Optimization (III)	System Analysis, Simulation and Optimization (III)
	14:00-14:25	QR2MSE	QR2MSE	QR2MSE	QR2MSE
		2022-0001-0007	2022-0008-0008	2022-0008-0017	2022-0003-0005
	14:25-14:50	QR2MSE	QR2MSE	QR2MSE	QR2MSE
Oral		2022-0002-0026	2022-0001-0025	2022-0003-0020	2022-0004-0017
A	14:50-15:15	QR2MSE	QR2MSE	QR2MSE	QR2MSE
		2022-0008-0006	2022-0008-0021	2022-0003-0007	2022-0005-0003
	45.45 45.40	QR2MSE	QR2MSE	QR2MSE	QR2MSE
	15:15-15:40	2022-0002-0027	2022-0008-0018	2022-0001-0003	2022-0007-0006
15:40-16:10			Tea	Break	

July 28 [Thursday] 16:10-18:00

Time	Room	Conference Room 1	Conference Room 3	Conference Room 4	Conference Room 7
Conference Topic		Reliability Modeling and Risk Analysis (I)	Reliability Modeling and Risk Analysis (I)	System Analysis, Simulation and Optimization (III)	System Analysis, Simulation and Optimization (III)
	16:10-16:35	QR2MSE 2022-0002-0010	QR2MSE 2022-0001-0031	QR2MSE 2022-0003-0015	QR2MSE 2022-0007-0019
Oral	16:35-17:00	QR2MSE 2022-0008-0003	QR2MSE 2022-0001-0032	QR2MSE 2022-0003-0019	QR2MSE 2022-0001-0035
B	17:00-17:25	QR2MSE 2022-0008-0022	QR2MSE 2022-0002-0007	QR2MSE 2022-0006-0012	QR2MSE 2022-0006-0003
	17:25-17:50	QR2MSE 2022-0001-0034	QR2MSE 2022-0008-0009	QR2MSE 2022-0008-0020	QR2MSE 2022-0007-0005
18:00			Diı	nner	



July 29 [Friday] 08:30-12:00

Room Time	Grand Banquet Hall		
08:30-09:10	Chair: Prof. Hong-Zhong Huang University of Electronic Science and Technology of China, China	Keynote Speech 5: Liyang Xie, PhD, professor Northeastern University, China Reliability Methods – From Theory to Application	
09:10-09:50	Chair: Prof. Zhencai Zhu China University of Mining and Technology, China	Keynote Speech 6: Shuncong Zhong, PhD, Chair Professor Fujian Provincial Key Laboratory of Terahertz Functional Devices and Intelligent Sensing, Fuzhou University, China Terahertz Nondestructive Testing and Quantitative Evaluation	
09:50-10:20	Tea Break		
10:20-11:00	Chair: Prof. Yu Liu University of Electronic Science and Technology of China, China	Keynote Speech 7: Xian-Cheng Zhang, PhD, Professor East China University of Science and Technology, China Progress in Creep-Fatigue Life Design for High-Temperature Structures	
11:00-11:40	Chair: Prof. Shubin Si Northwestern Polytechnical University, China	Keynote Speech 8: Paolo Gardoni, PhD, Professor, RESS Editor-in-Chief University of Illinois at Urbana-Champaign, USA An Overview of Regional Risk and Resilience Analysis	
12:00-14:00	Lunch		



July 29 [Friday] 14:00-16:10

Time	Room	Conference Room 1	Conference Room 3	Conference Room 4	Conference Room 7
Confer	ence Topic	Maintenance and Warranty Management (VI)	Failure Physics, Material Science, Data Analysis, and Reliability Testing (VII)	Reliability Modeling and Risk Analysis (I)	Fault Diagnosis, Prognosis, Condition Monitoring and PHM (IV)
	14:00-14:25	QR2MSE 2022-0006-0006	QR2MSE 2022-0004-0005	QR2MSE 2022-0002-0025	QR2MSE 2022-0005-0004
Oral	14:25-14:50	QR2MSE 2022-0008-0019	QR2MSE 2022-0005-0001	QR2MSE 2022-0007-0009	QR2MSE 2022-0001-0028
C	14:50-15:15	QR2MSE 2022-0001-0021	QR2MSE 2022-0007-0020	QR2MSE 2022-0001-0006	QR2MSE 2022-0003-0009
	15:15-15:40	QR2MSE 2022-0006-0007	QR2MSE 2022-0007-0018	QR2MSE 2022-0001-0008	QR2MSE 2022-0004-0004
15:40-16:10		Tea Break			

July 29 [Friday] 16:10-18:00

Time	Room	Conference Room 1	Conference Room 3	Conference Room 4	Conference Room 7
Conference Topic		Maintenance and Warranty Management (VI)	Failure Physics, Material Science, Data Analysis, and Reliability Testing (VII)	Reliability Modeling and Risk Analysis (I)	Fault Diagnosis, Prognosis, Condition Monitoring and PHM (IV)
	16.10-16.30	QR2MSE	QR2MSE	QR2MSE	QR2MSE
	10.10-10.50	2022-0006-0008	2022-0004-0009	2022-0006-0004	2022-0008-0010
	16:30-16:50	QR2MSE	QR2MSE	QR2MSE	QR2MSE
		2022-0002-0013	2022-0001-0014	2022-0008-0011	2022-0001-0033
Oral	16:50-17:10	QR2MSE	QR2MSE	QR2MSE	QR2MSE
D		2022-0002-0011	2022-0004-0002	2022-0002-0006	2022-0003-0002
	17:10-17:30	QR2MSE	QR2MSE	QR2MSE	QR2MSE
		2022-0004-0008	2022-0008-0012	2022-0002-0019	2022-0001-0030
	17:30-17:50	QR2MSE	QR2MSE	QR2MSE	QR2MSE
		2022-0002-0009	2022-0003-0013	2022-0002-0017	2022-0008-0013
19:00		Banquet			



VI. Technical Program

July 28 [Thursday] Oral Session A in Conference Room 1

14:00-15:40	Reliability Modeling and Risk Analysis (I)
Moderators:	Chen Fang, Zhejiang Ocean University, China
	Bao-Ping Cai, China University of Petroleum, China

14:00-14:25 QR2MSE2022-0001-0007 Structural Operational Integrity - The More Comprehensive General Quality Characteristic of Structure / Yuting He (Air Force Engineering University)

In this paper, the author discussed equipment storage integrity and equipment operational integrity along the life cycle time, and the basic concept of structural operational integrity is shown.

14:25-14:50 QR2MSE2022-0002-0026 Embryonics-Based Reconfigurable Digital System for Aerospace Applications / Libiao Peng (University of Electronic Science and Technology of China), Dongjie Bi, XiFeng Li, Yu Tang, Lei Peng and Yongle Xie

In this paper, a FPGA+DSP based heterogeneous multi-core digital system hardware design scheme is proposed.

14:50-15:15 QR2MSE2022-0008-0006 A Reliability-Based Expected Improvement in Global Reliability Design Optimization / Yong Pang (Dalian University of Technology), Wei Sun and Xueguan Song

This paper proposed a reliability-based expected improvement (RBEI) method for the kriging model based on the inverse MPP solution.

15:15-15:40 QR2MSE2022-0002-0027 Reliability Analysis and Optimization of PMSs with Backup/Rescue Missions and Mixed Redundancy Strategy / *Xiangyu Li (Taiyuan University of Technology), Xiaopeng Li and Xiaoyan Xiong*

In this paper, the reliability optimization of PMSs with backup/rescue missions and mixed redundancy strategy is studied.



14:00-15:40	Reliability Modeling and Risk Analysis (I)
Moderators:	Jie Liu, Hunan University, China
	Yuan Chen, China Electronic Product Reliability and Environmental Test Institute, China

14:00-14:25 QR2MSE2022-0008-0008 Evidence Theory-Based Reliability Design Optimization Using Multi-Fidelity Model / Jie Liu (Hunan University), Yue Zhao and Lixiong Cao

In this paper, an efficient reliability design optimization method based on multi-fidelity (MF) model is proposed.

- 14:25-14:50 QR2MSE2022-0001-0025 Reliablity Estimation and Risk Assessment of the Human Spine Based on Wiener Process / Tong Wu, Changxi Wang (Sichuan University), Kerui Zhang, Kang Li and Yao Cheng In this paper, the authors explore the potential for applying statistic model to characterize the degeneration of human spine.
- 14:50-15:15 QR2MSE2022-0008-0021 Possibilistic Chance-Constrained Data Envelopment Analysis Framework for Failure Modes and Effects Analysis / Jing Zhou (University of Electronic Science and Technology of China), Guotao Wang and Yu Liu

In this paper, the authors propose three categories of the DEA approach under the Me measure to form FMEA.

15:15-15:40 QR2MSE2022-0008-0018 A Resilience Optimization Method for Converter Station Systems Under Uncertain Mainshock-Aftershock Sequences / Kai Wang (University of Electronic Science and Technology of China), Zhihang Xue, Changjie Zou, Yu Liu and Changhua Zhang

This paper proposed a resilience optimization method for converter station systems under uncertain mainshock-aftershock sequences.



14:00-15:40	System Analysis, Simulation and Optimization (III)
Moderators:	Jihong Pang, Shaoxing University, China
	Kaiye Gao, Beijing Information Science and Technology University, China

14:00-14:25 QR2MSE2022-0008-0017 A Novel Importance Measure for Multilevel Inspection Strategy of Hierarchical Multistate Systems: From Value of Information Perspective / Boyuan Zhang (University of Electronic Science and Technology of China), Tangfan Xiahou, Qin Zhang and Yu Liu

This paper proposed I2M to improve the probability of mission success of a repairable hierarchal multistate systems.

14:25-14:50 QR2MSE2022-0003-0020 Target Search of UAV Swarm through Information Augment and Direction Adjustment / Bin Wu (Northwestern Polytechnical University), Wenjin Zhu, Luohaoji Wang and Qisheng Jiang

In this paper, a UAV swarm model considering communication range and node degree is proposed based on complex network.

14:50-15:15 QR2MSE2022-0003-0007 Linear System Design with Application in Wireless Sensor Networks / Kaiye Gao, Hui Xiao, Rui Peng, Yue Ren (Beijing Information Science and Technology University), Liudong Xing and Shouyang Wang

This paper contributes by modeling the reliability of a linear multi-state consecutively connected system (LMCCS).

15:15-15:40 QR2MSE2022-0001-0003 Quality Assessment of Analog to Digital Converter Chip Using Test Data Set / Kai Sun, Jie Fu (University of Chinese Academy of Sciences), Panpan Zhang, Danyu Wu and Xinyu Liu

This paper develops a method named quality-spectrum to analyzing ADC quality characteristics using its data set.



14:00-15:40 System Analysis, Simulation and Optimization (III)

Moderators: Yan-Feng Li, University of Electronic Science and Technology of China, China Ancha Xu, Zhejiang Gongshang University, China

14:00-14:25 QR2MSE2022-0003-0005 Joint Optimization of Resource Allocation and Maintenance Planning for Multi-Facility Infrastructure Systems / Yue Shi (Texas Tech University), Yisha Xiang and Chao Fang

This paper gives an integrated resource allocation and maintenance planning with complex maintenance effects for infrastructure systems consisting of multiple facilities.

14:25-14:50 QR2MSE2022-0004-0017 A deep learning model towards fault diagnosis of drilling pump using strain signal / Junyu Guo (Southwest Petroleum University) and Le Dai

In this paper, a deep learning model based on the combination of WaveletKernelNet and bidirectional gated recurrent unit is proposed for the intelligent fault diagnosis of oil drilling pumps.

14:50-15:15 QR2MSE2022-0005-0003 Resilience Modeling of Multi-component Systems / Zhizhong Tan (Northwestern Polytechnical University), Bei Wu and Ada Che

This paper developed a resilience model for a multi-component system.

15:15-15:40 QR2MSE2022-0007-0006 Experimental study on failure of the scratched engine intake pipe under high temperature air burning / Wei Liu (Northwestern Polytechnical University), Hongyan Zhu, Meng Wu and Wangzhen Li

In this paper, the tolerances of working pressures and high-temperature air burning of the intake pipe were experimental investigated.



16:10-17:50	Reliability	Modeling	and Risk	Analysis	(I)
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Moderators: Bin Wu, Aero Engine Academy of China, China

Dequan Zhang, Hebei University of Technology, China

16:10-16:35 QR2MSE2022-0002-0010 Reliability Reallocation of Civil Aircrafts Based on Operational Data / Shilie He (China Electronic Product Reliability and Environmental Test Institute), Yuanhua Ni, Zhenwei Zhou, Yun Huang, Junbin Liu and Hanguang Jia

In this paper, the reliability reallocation problem of civil aircrafts is investigated based on operational data.

16:35-17:00 QR2MSE2022-0008-0003 An Improved Finite Step Length Method for Structural Reliability Analysis and its Application in RBDO / Dequan Zhang (Hebei University of Technology), Jingke Zhang, Meide Yang and Xu Han

In this paper, an improved finite step length (IFSL) method to accelerate the convergence speed is proposed to improve the efficiency of the FSL method to search the most probable point (MPP).

17:00-17:25 QR2MSE2022-0008-0022 An Efficient Uncertainty Propagation Technique for Complicated Aviation Structure / Yan Shi (University of Electronic Science and Technology of China), Tudi Huang, Yan-Feng Li and Yu Liu

An efficient Kriging surrogate model-based uncertainty propagation technique for dealing with time-consuming uncertainty propagation of complicated aviation structure is proposed in this work.

17:25-17:50 QR2MSE2022-0001-0034 Fault Tolerant Property of Interdependent Networks / Xifeng Li (University of Electronic Science and Technology of China), Dongjie Bi, Libiao Peng, Yu Tang, Juan Xu and Yongle Xie

This paper proposes a cascading failure model with the consideration of the fault tolerance property of the nodes in interdependent networks to deeply understand the relationship between the fault-tolerance assignment and the robustness of inter-dependent networks.



16:10-17:50 Reliability Modeling and Risk Analysis (I)

Moderators: Yingkui Gu, Jiangxi University of Science and Technology, China Xiaoling Zhang, University of Electronic Science and Technology of China, China

16:10-16:35 QR2MSE2022-0001-0031 Development of an Aircraft Collision Risk Assessment Model / Mingliang Chen (China Academy of Civil Aviation Science and Technology), Yuan Zhang, Min Luo and Yanqiu Chen

In this paper, aircraft collision events occurred from 2016 to 2021 are analyzed and shows results with the actual situation.

16:35-17:00 QR2MSE2022-0001-0032 Structural Fuzzy Reliability Analysis Method with Less Sample Data based on Support Vector Machine / Xiaobo Nie (Inner Mongolia University of Technology), Haibin Li, Hongxia Chen, Honghua Sun and Jianping Yang

In this paper, a novel fuzzy reliability analysis method based on support vector machine is proposed.

17:00-17:25 QR2MSE2022-0002-0007 Reliability Evaluation of Supercapacitors Based on Pseudo-Failure Calendar Lifetime Distribution / Pengfei Yu (South China University of Technology), Gang Wang, Yun Huang, Chuangmian Huang and Guoguang Lu

This paper proposed the pseudo-failure calendar lifetime distribution and reliability evaluation of supercapacitors.

17:25-17:50 QR2MSE2022-0008-0009 Inverse Uncertainty Quantification of Positioning Accuracy for Industrial Robot End-Effector / Jinhe Zhang (Hunan University), Jie Liu and Fei Ding

In this article, a novel inverse uncertainty quantification method based on orthogonal matching pursuit is proposed for industrial robot with imprecise positioning.



16:10-17:50 System Analysis, Simulation and Optimization (III)

Moderators: Haibin Li, Inner Mongolia University of Technology, China Rong Yuan, Chengdu University, China

16:10-16:35 QR2MSE2022-0003-0015 Design and Optimizetest of Cleaning and Grading Equipment for Ruditapes Philippinarum / Lanlan Pan (Dalian Ocean University), Yongjie Wang, Weiwen Huang, Bing Qu and GuoChen Zhang

In this paper, the authors designed and developed a kind of integrated cleaning and classification equipment for ruditapes philippinarum.

16:35-17:00 QR2MSE2022-0003-0019 Optimal Pricing for Customized Two-Dimensional Extended Warranty Policies / *Rui Zheng (Hefei University of Technology)*

This paper developed a pricing model for two-dimensional extended warranty policies.

17:00-17:25 QR2MSE2022-0006-0012 A Heuristic Maintenance Scheduling Framework for An Aircraft Fleet Under Limited Resources / Qin Zhang (University of Electronic Science and Technology of China), Tangfan Xiahou, Boyuan Zhang and Yu Liu

In this paper, a new maintenance scheduling framework for a military aircraft fleet is formulated with the aim of maximizing the expected fleet readiness.

17:25-17:50 QR2MSE2022-0008-0020 Simulation-Based Optimization for Preventive Maintenance of Heat Treatment Production Line / *Mingang Yin (University of Electronic Science and Technology of China), Qin Zhang and Yu Liu*

A model of heat treatment production line is established in this paper.



16:10-17:50	System Analysis, Simulation and Optimization (III)
Moderators:	Wenxue Qian, Northeastern University, China

Jinhua Mi, University of Electronic Science and Technology of China, China

16:10-16:35 QR2MSE2022-0007-0019 In-plane Mechanical Properties Analysis of Hexgonal Honeycomb with Enhanced Joints / Song Pang (University of Electronic Science and Technology of China), Zhi Zeng, Yanfu Yang and Xiaoling Zhang

This paper focuses on the influence of the joint of hexagonal honeycomb structures on the in-plane equivalent elastic modulus and resilience ability.

16:35-17:00 QR2MSE2022-0001-0035 Reliability Analysis Based on Active Learning Kriging Model for Problems Involving Multimodally Distributed Random Variables / *Xin Cheng, Tai Wang (Southwest Jiaotong University), Jie Deng and Xufeng Yang*

In this paper, a novel strategy, integrating the λ Mixture Model (λ MM) and the Active Learning Kriging model (ALK), is proposed to cope with the problems involving multimodally distributed random variables.

17:00-17:25 QR2MSE2022-0006-0003 An Optimal Condition Based Maintenance Model for Accelerated Degrading Products / Renging Li (CEPREI Laboratory), Jin Li, Yan Song, Kun Wang, Tianxiang Luo and Jiale Lu

In this paper, the maintenance process of accelerated degradation process is illustrated and an accelerated degradation model based on the Inverse-Gaussian process is built.

17:25-17:50 QR2MSE2022-0007-0005 A sequential sampling approach based on LOLA-DIST criterion / Jian Zhong (National University of Defense Technology), Zhi-Jun Cheng, Jun Fan, Zheng-Qiang Pan and Sen-Yang Bai

A sequential experimental design method based on LOLA-DIST (Local Linear Approximations, LOLA, the intersite and projected distance, DIST) criterion is proposed.



14:00-15:40 Maintenance and Warranty Management (VI)

Moderators: Huanwei Xu, University of Electronic Science and Technology of China, China Guangjun Jiang, Inner Mongolia University of Technology, China

14:00-14:25 QR2MSE2022-0006-0006 Jointly optimizing lot sizing and maintenance policy for a production system with two failure mode / Kaiye Gao (Beijing Information Science and Technology University), Rui Peng, Li Qu, Shaomin Wu, Yujia Yang and Li Yang

This study examines the joint optimization of lot sizing and maintenance policy for multi-product production system affected by two failure modes.

14:25-14:50 QR2MSE2022-0008-0019 Reliability Assessment of Systems with State Transition Dependency and Unilateral Degradation Dependency / Tao Yin (University of Electronic Science and Technology of China), Tao Jiang and Yu Liu

A new reliability model for systems with state transition dependency and unilateral degradation dependency is developed in this paper.

14:50-15:15 QR2MSE2022-0001-0021 Reliability Modeling of Linear Degradation Process Considering Zoned Shock Effects under Markovian Environments / Yamei Zhang (Northwestern Polytechnical University), Songzheng Zhao and Bei Wu

This paper considers competing failure processes and proposes a reliability model applicable to linear degradation and random shock systems, where the natural degradation rate and shock arrival rate are influenced by the dynamic environment.

15:15-15:40 QR2MSE2022-0006-0007 A Preventive Maintenance Policy Considering Imperfect Inspection and Imperfect Repair for A Three-Stage Degradation / *Xia Tang (Southwestern University of Finance and Economics), Hui Xiao, Rui Peng and Ye-Fang Chen*

This paper proposes a preventive maintenance strategy that considers imperfect inspection and imperfect repair of a system in three stages of degradation.



14:00-15:40 Failure Physics, Material Science, Data Analysis, and Reliability Testing (VII)

Moderators: Kai Sun, Institute of Microelectronics of Chinese Academy of Sciences, China Xiangyu Li, Taiyuan University of Technology, China

 14:00-14:25
 QR2MSE2022-0004-0005
 Remaining Useful Life Prediction of Bearings Based on GCN and Bi-LSTM /

 Guyue Gao (Shanghai Jiao Tong University), Ben Zhao, Xuemei Chang and Xinguo Ming

This paper proposes a bearing RUL prediction model based on GCN and Bi-LSTM to improve the accuracy of bearing RUL prediction.

14:25-14:50 QR2MSE2022-0005-0001 Resilience Analysis for Tightly Coupled Constellations of Teams / Wenjie Ma (Aerospace Dongfanghong Satellite Co,. Ltd.), Ruiying Li, Jing Wang, Yeqing Song and Fei Feng

In this paper, we propose a resilience analysis framework for tightly coupled constellations of teams. A tri-satellite constellation of four teams is used as a case to verify the effectiveness of this method.

14:50-15:15 QR2MSE2022-0007-0020 An Imprecise Probability Method Applied Power-normal Model in Accelerated Life Testing / Yi-Chao Yin (Chongqing University of Science and Technology) and Jungang Yin

This paper presents a new nonparametric predictive inference method using a power-normal model for accelerated life testing (ALT).

15:15-15:40 QR2MSE2022-0007-0018 Research of Critical Component Identification Method for Spacecraft Dimensional Stability Based on Contribution Rate / *Guoqing Liu (Beihang University), Wenbo Luo, Chunjie Wang and Haoyu Deng*

Identifying components that have a great impact on dimensional stability through the contribution rate defined in this paper, and carrying out targeted dimensional stability design.



14:00-15:40Reliability Modeling and Risk Analysis (I)Moderators:Junxi Bi, Inner Mongolia University of Technology, ChinaYichao Yin, Chongqing University of Science and Technology, China

14:00-14:25 QR2MSE2022-0002-0025 Health Assessment of Aerospace Vehicle Power Distribution System Based on Virtual Simulator / Juan Chen (Beihang University), Hao Liu, Zhiqiang Li, Jianguo Wu, Jingkun Wei, Changlin Wu and jia Li

This paper provides an effective solution by analyzing simulation data set to assess the health and predict life of aerospace vehicle.

14:25-14:50 QR2MSE2022-0007-0009 Key Meta-Action Identification for CNC Machine Tool under Dual-criteria / Pengbiao Zhang (Chongqing University), Xiao Zhu, Xiang Gao, Yu Ji and Yan Ran

In this paper, the importance of meta-actions is analyzed under the dual-criteria of the CNC machine tool reliability and accuracy.

14:50-15:15 QR2MSE2022-0001-0006 Wind Turbine Reliability Analysis with Fault-Related Weighted Bayesian Networks / Chenbing Zhang (Inner Mongolia University of Technology), Ying Wang, Xin Li and Zhen Liu

In this paper, a reliability evaluation model of wind turbines considering fault-related weighted Bayesian network is established to realize the reliability analysis of wind turbines.

15:15-15:40 QR2MSE2022-0001-0008 Vibration Reliability Analysis of Circular Saw Blade for Salix Flat Stubble / Weihua Cheng (Inner Mongolia University of Technology), Zhigang Liu and Chenghui Pei

In this paper, the structural reliability analysis of flat stubble circular saw blade is carried out to solve the damage of blade and the influence of vibration on the quality of flat stubble in the process of droplet sawing.



14:00-15:40	Fault Diagnosis, Prognosis, Condition Monitoring and PHM (IV)
Moderators:	Risu Na, Inner Mongolia University of Technology, China
	Xiaohong Hao, University of Electronic Science and Technology of China, China

14:00-14:25 QR2MSE2022-0005-0004 Reliability study on fatigue life of axles of square bale pick-up and stacker trucks / He Wang, Chenghui Pei (Inner Mongolia University of Technology), Zhigang Liu and JinHuang Ma

In this paper, reliability analysis of square bale pick-up and stacker trucks is performed.

 14:25-14:50
 QR2MSE2022-0001-0028
 Research on fatigue reliability of steel crane girder based on SVM /

 Zhanqing Xing (Inner Mongolia University of Technology) and Jing Pang

This paper introduces this method to analyze the reliability of crane girder fatigue failure.

14:50-15:15 QR2MSE2022-0003-0009 Optimization Design of Hypersonic Vehicle Propulsion System Based on ISIGHT and MATLAB / Xiaohua Zheng, Jianxin Wu (Inner Mongolia University of Technology), Hui Sun and Cunyou Su

This paper takes the American X-43A hypersonic aircraft as the basic configuration and combines MATLAB to compile the optimization program to realize the multi-objective optimization and reliability design of the aircraft propulsion system in ISIGHT.

15:15-15:40 QR2MSE2022-0004-0004 State of health estimation for lithium-ion battery based on fusion features / Yu Wang (National University of Defense Technology), Tao Zhang, Zhichao Shi, Mengda Cao, Wenkai Zhu and Yajie Liu

In this paper, the effectiveness of the proposed feature extraction method is verified by using SVR as the estimation model



16:10-17:50 Maintenance and Warranty Management (VI)

Moderators: Guangjun Jiang, Inner Mongolia University of Technology, China Haiqing Li, University of Electronic Science and Technology of China, China

16:10-16:30 QR2MSE2022-0006-0008 Reliability and maintenance modeling for competitive failure system / Yuxi Mai (Northwestern Polytechnical University), Bei Wu and Jianwu Xue

In this paper, a model is developed for systems subject to multiple dependent competing failure processes experiencing several imperfect maintenance actions before replacement within varying environments.

16:30-16:50 QR2MSE2022-0002-0013 Modified Nonlinear Cumulative Damage Model Considering Residual Strength Degradation and Gear Reliability Analysis / Gaohui Ding (Northwestern Polytechnical University), Zhiqiang Cai, Shubin Si and Yinze Yan

On the basis of the stress-strength interference model, a gear reliability model considering residual strength degradation was developed. The accuracy and validity of the modified Corten-Dolan model is verified by comparing experimental data.

16:50-17:10 QR2MSE2022-0002-0011 Reliability Assessment of Switching Mode Power Supply considering Capacitor Degradation / Zichuan Zhao (Harbin Institute of Technology), Kangjian Gong, Lianyu Su, Xuerong Ye and Guofu Zhai

This paper proposes a reliability assessment method for SMPS based on the film capacitor degradation to made sufficient use of component-level degradation information.

17:10-17:30 QR2MSE2022-0004-0008 The Study of Failure Characteristics of MCU based on the After-sale Reverse Analysis / Jiang Xia, Qiang Lei, Shiman Xiao, Jiqiu Tang, Kai Huang, Baojun Qiu (China Electronic Product Reliability and Environmental Testing Research Institute) and Xiaoqiang Wang

This paper takes mainstream smart door lock products on the market as the research object, and a series of failure analyses and root cause searches are executed to find the reasons for master control chip failure.

17:30-17:50 QR2MSE2022-0002-0009 Multi-Physics Coupling Test Design and Failure Analysis of Intelligent Door Lock / Jiang Xia (China Electronic Product Reliability and Environmental Testing Research Institute), Jiqiu Tang, Kai Huang, Shiman Xiao, Baojun Qiu and Yuan Tu

> In this paper, the multi-physical field coupling test of the intelligent door lock was firstly designed based on the actual service scenario of the product.



16:10-17:50 Failure Physics, Material Science, Data Analysis, and Reliability Testing (VII)

Moderators: Zhiqiang Cai, Northwestern Polytechnical University, China Junyu Guo, Southwest Petroleum University, China

16:10-16:30 QR2MSE2022-0004-0009 Diagnosis Model of Prostate Cancer Based on Machine Learning Algorithm / Zhentao Xiao (Northwestern Polytechnical University), Tianyi Wang, Chi Zhang and Zhigiang Cai

In this paper, the data cleaning and statistical analysis are carried out, and 28 predictive variables are selected and extracted to predict prostate cancer patients and improve the diagnostic efficiency of prostate cancer.

16:30-16:50 QR2MSE2022-0001-0014 A Two-Phase Wiener Process Model Considering Change Process of Degradation / Mulin Huang (Beihang University), Tingting Huang and Xin Wu

In this paper, a two-phase degradation model is proposed assuming that the failure mechanism is time linearly changing in change process.

16:50-17:10 QR2MSE2022-0004-0002 LSTM and ELM Based Transfer Learning Approach for Online Bearing Remaining Useful Life Prediction / Junhui Huang (Beihang University), Mei Yuan, Jin Cui, Juanru Zhao, Yufeng Qu and Shaopeng Dong

In this paper, a non-linear fusion transfer learning method based on long-short term memory networks (LSTM) and extreme learning machines (ELM) is proposed to realize online bearing RUL prediction, especially in the late degradation stage.

17:10-17:30 QR2MSE2022-0008-0012 The Integrated Application of Visual Force Measurement / Zelun Li (Chongqing University of Science and Technology) and Zhongliang Lv

This paper proposed "robot + detection", high-precision mechanical size measurement system and method.

17:30-17:50 QR2MSE2022-0003-0013 An Imporved Algorithm to Enumerate All Minimal Cuts in a Network / Junsen Li (National University of Defense Technology), Guanghan Bai, Xinxin Zhou and Junyong Tao

In this paper, an improved algorithm is proposed for finding all MCs in two-terminal networks that consist of a source node and a sink node.



16:10-17:50	Reliability Modeling and Risk Analysis (I)	
Moderators:	Yan-Feng Li, University of Electronic Science and Technology of China, China	
	Honghua Sun, Inner Mongolia University of Technology, China	

16:10-16:30 QR2MSE2022-0006-0004 Analysis of the Application Prospects of Reliability-Centered Maintenance in the Operation and Maintenance Management of Air Traffic Control Equipment / *Qiang Zhang, Haobo Jiao (Civil Aviation Flight University of China) and Jiangtao Qi*

This paper reviews the development history and application background of RCM method in aviation and other equipment fields.

16:30-16:50 QR2MSE2022-0008-0011 Fault Feature Extraction of Rolling Bearings Based on Adaptive Variational Modal Decomposition and PSO optimized Multiscale Fuzzy Entropy / *Zhongliang Lv and Senping Han(Chongging University of Science and Technology)*

A fault feature extraction method based on the combination of Adaptive Variational Modal Decomposition (AVMD) and PSO optimized Multiscale Fuzzy Entropy (MFE) is proposed in this paper.

16:50-17:10 QR2MSE2022-0002-0006 Multi-state reliability evaluation of meta-action unit based on Semi-Markov / Xiao Zhu, Yan Ran (Chongqing University), Pengbiao Zhang and Xiang Gao

This paper proposes a multi-state reliability evaluation method of MAU based on Semi-Markov model.

17:10-17:30 QR2MSE2022-0002-0019 Uncertainty analysis of light and thin bulk material movement / Fancai Liu, Jianxin Wu (Inner Mongolia University of Technology), Guangwei Li and Le Du

This paper summarizes and analyzes the processes and equipment involved in the production line of thin and light bulk ice cream sticks.

17:30-17:50 QR2MSE2022-0002-0017 Uncertainty Analysis of Wind Turbine Wind Speed Considering Spatial and Temporal Distribution / *Cunyou Su (Inner Mongolia University of Technology), Jianxin Wu, Hui Sun, Guangwei Li and Le Du*

This paper puts forward the problems and deficiencies in the current wind speed uncertainty analysis of wind power generation.



16:10-17:50 Fault Diagnosis, Prognosis, Condition Monitoring and PHM (IV)

Moderators: Nan Zhang, Inner Mongolia University of Technology, China Faqun Qi, Wenzhou university, China

16:10-16:30 QR2MSE2022-0008-0010 Research on Weak Fault Diagnosis Method of Rolling Bearing Based on MVO-MOMEDA under Strong Noise Interference / Zhongliang Lv and Linhao Peng (Chongqing University of Science and Technology)

Weak fault diagnosis method of rolling bearing based on MVO-MOMEDA under strong noise interference is proposed in this paper.

16:30-16:50 QR2MSE2022-0001-0033 Degradation modeling and life prediction of double-nut ball screws by integrating performance simulation and physics-of-failure / Juan Chen (Beihang University), Changlin Wu, Yong Liu, Zhiguo Zeng, Jingkun Wei and Zhuangyin Liu

This paper propose a reliability evaluation method that integrates functional performance simulation with physics-of-failure models.

16:50-17:10 QR2MSE2022-0003-0002 Optimal Inspection for Systems with Protective Auxiliary Component in Dynamic Environments / Yao Duan (Nanjing University of Science and Technology), Jingyuan Shen, Xiavu Cai and Shangshang Cong

The present paper studies a multi-component system subject to dynamic environments/operating conditions.

17:10-17:30 QR2MSE2022-0001-0030 A New Reliability Method Based on Markov Chain Monte Carlo and Kriging Model for Small Failure Probability / Huanwei Xu, Wei Zhang (University of Electronic Science and Technology of China), Jingtian Zhang, Naixun Zhou and Lu Xiao

A reliability analysis method based on Markov chain Monte Carlo (MCMC) and Kriging model is proposed for the small failure probability problem.

17:30-17:50 QR2MSE2022-0008-0013 Fault Diagnosis of Rotating Machinery Based on Deep Learning Using Various Data Processing / Ziwei Xu (University of Electronic Science and Technology of China), Hong-Zhong Huang and Sajawal Gul Niazi

In this paper, four DL-based models which consist of multi-layer perception (MLP), convolutional neural network (CNN), Bi-directional Long short-term memory (BiLSTM), and autoencoder (AE) on IEEE PHM Challenge 2012 dataset with two data split strategies and three normalization methods are proposed to clarify the differences made by various data processing.



VII. Conference Information

A. Conference Floor

Floor for Oral Sessions



The 2nd Floor of Le Meridien Emei Mountain Resort









B. Registration

论文版面费	金额	备注
论文版面费和会议注册费	3000 元/篇(不检索)	不少于 5 页,超过 8 页的每页加收 100 元。
	3500 元/篇(EI 检索)	
 学生论文版面费和会议注册费	2500 元/篇(不检索)	第一作者为学生且学生参会,需出示学生证明;
	3000 元/篇(EI 检索)	字生汪册费个含会议礼品。
多篇文章版面费	1500 元/篇	同一作者提交多篇文章的,除第一篇文章外每篇 文章收取会议版面费 1500 元。
多人参会	2500 元/人	同一篇文章多位作者参会的,一位作者正常注册, 其余作者按无论文参会收取会议注册费 2500 元 /人。
无论文参会者注册	2500 元/人	无

C. Transportation

Address: No. 555, South Mingshan Road, Emeishan, Leshan, Sichuan (At the red mark in the picture)





Access to Le Meridien Emei Mountain Resort

From Chengdu Shuangliu International Airport



Shuangliu International Airport



Le Meridien Emei Mountain Resort

Recommended routes:

1. **We By High Speed Railway:** Take high speed railway from **the Shuangliu Airport Railway Station**, get off at **the Emeishan Railway Station**, then

① **Take a taxi** : about ¥ 10, 5 minutes.

② By bus: Get on the No.12 bus from the High Speed Railway Emeishan Bus Station, get off at the Tianxiamingshan Bus Station. It takes about 25 minutes. Operation time: 7:00-21:00.

From Chengdu East Railway Station





Chengdu East Railway Station

Le Meridien Emei Mountain Resort

Recommended routes:

1. **We By High Speed Railway:** Take high speed railway from **the Chengdu East Railway Station**, get off at **the Emeishan Railway Station**, then

1 *Take a taxi* : about ¥ 10, 5 minutes.

② By bus: Get on the No.601 bus from the High Speed Railway South Square Bus Station, get off at the Tianxiamingshandong Bus Station. It takes about 23 minutes. Operation time: 7:00-19:00.

From Chengdu Railway Station



Chengdu Railway Station



Le Meridien Emei Mountain Resort

Recommended routes:

1. **We By High Speed Railway:** Take high speed railway from **the Chengdu Railway Station**, get off at **the Emeishan Railway Station**, then

① **Take a taxi** : about ¥ 10, 5 minutes.

② By bus: Get on the No.8 bus from the High Speed Railway South Square Bus Station, get off at the Tianxiamingshandong Bus Station. It takes about 20 minutes. Operation time: 6:40-20:00.



From Chengdu South Railway Station





Le Meridien Emei Mountain Resort

Recommended routes:

1. **We By High Speed Railway:** Take high speed railway from **the Chengdu South Railway Station**, get off at **the Emeishan Railway Station**, then

① **Take a taxi** : about ¥ 10, 5 minutes.

② By bus: Get on the No.8 bus from the High Speed Railway South Square Bus Station, get off at the Tianxiamingshandong Bus Station. It takes about 20 minutes. Operation time: 6:40-20:00.

Contact information of conference secretariat

On-site helpers and volunteers at Emeishan Railway Station and Le Meridien Emei Mountain Resort are as follows.

Mr. Xin Huang	+86 180 4854 9553	Emeishan Railway Station
Mr. Ze-Qi Zhong	+86 132 8182 7294	
Mr. Guang Ren	+86 188 4710 8993	Le Meridien Emei Mountain Resort

* Please do contact the conference secretariat if you need any help on transportation.



D. General Information

About Emeishan

Located southwest of Sichuan Province, **Emeishan City**, which shares a same name (峨眉山) with the famous Emeishan Mountain (Emei Mountain or Mount Emei) in Mandarin Chinese, is situated **130** kilometers southwest of the capital city of Chengdu. The Emei Mountain situated in the Emeishan City is renowned for its rank as the **highest** of the Four Sacred Buddhist Mountains of China (3,099 metres high) and its nomination as a **UNESCO World Heritage Site** together with the Leshan Giant Buddha since 1996. Travelers looking for some marvelous hikes will just be satisfied with the landscapes displayed there especially during the sunrise and clouds sea sightseeing, available from **the Golden Summit** of the mountain. Home to many Tibetan macaques (monkeys), the scenery in Emei Mountain is just a delight that everyone will enjoy during the climbing. More than a sacred place, Emeishan is also a pure natural beauty attracting hordes of pilgrims and tourists every day. While facing the Emeishan, travelers are impressed by the 76 Buddhist Monasteries located throughout the paths and strangely adapting their architecture to the landscape. On foot or taking cable cars, climbing the Emei Mountain is a worth visiting highlight of the Sichuan Province that will let travelers walk on the definitely most famous sacred mountain of China!





About Tourism

Golden Summit (金顶)

With an altitude of 3079 m, Golden Summit is the **second highest peak of Mount Emei and the highest part that tourists can get to**. It's the symbol and essence of Mount Emei. On the summit, there is a bronze hall. When the sun shines on the bronze hall, its brightness dazzles the eyes just like the golden light, thus it is called Golden Summit. Stand on the Golden Summit and look afar, Chengdu Plain, Ming River, Qingyi River, Dadu River, Gongga Mountain and Wawu Mountain are all in view. The Golden Buddha on the summit is the tallest Samantabhadra (Puxian Buddha) golden statue in the world. The statue is 48 m high and weighs 660 metric tons. It's a gilded bronze statue which is designed by famous designer Li Zuyuan in Taiwan. The statue has ten heads facing ten different directions in three layers, which symbolizes those Buddhas in previous, present, future life and ten practices and wishes of Puxian Buddha.In the Golden Summit, travelers can also see the four wonders of Mount Emei: the Sunrise, Cloud Sea, Buddha's Halo and Holy Light.





Leidongping (雷洞坪)

Leidongping is located at Lianwang Slope, with an altitude of 2430 m. The snow here can last for a long time and the slope is also very suitable for skiing, thus, a ski resort has been opened nearby. The way from Leidongping to Jieyin Hall is covered with alpine azaleas. Early summer is the most beautiful time for the azaleas while bright purples and reds cover the ground during this time. There is an azalea tree which is 13 m high with a diameter of 2.7 m. The tree is over 450 years old and it's definitely the "Queen of Azalea". Leidong Smoke Cloud is a meteorological phenomenon in the high and cold zone of Mount Emei. After a night's rainfall, the smoke cloud will rise from the forests and sway with the wind, which forms a stunning and changeable scenery.





Wannian Temple (万年寺)

Wannian Temple is also one of the top eight temples in Mount Emei and it's the largest one. Located 15 km from Baoguo Temple and with an altitude of 1020 m, it is first built in Eastern Jin Dynasty (A.D. 317 ~ 420). Wannian Temple is featured for worshiping the bronze statue of Samantabhadra. It has many Buddhist halls. Apart from the halls, there are gardens, pavilions and ponds. One of the highlights of Wannian Temple is the Brick Hall, which was built with bricks and no beams are used in the construction. The Brick Hall has survived 18 earthquakes over the past 400 years, and it's one of the construction miracles in China.





Ecological Monkey Zone (生态猴区)

Mount Emei has the largest Ecological Monkey Zone in China. There are about 1000 monkeys mainly distributed in the area between 800 meters and 2400 meters above sea level. You are most likely to encounter them near Hongchunping, Xixiangchi, Yixiantian, etc. Monkeys here are used to tourists. They will jump from one tree to another at ease and may grab the food from your hands. So if you are not intended to feed them or are afraid of them, don't take any food on your hands and make sure your bag is zipped up. But if you are ok with the monkeys, here is the place you can have a lot of fun with them.

