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EDITORIAL

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Special issue: Reliability management of complex system

Nowadays, reliability is moving toward interdisciplinary research with ever-increasing connotations for full life-cycle system management, including system design, analysis, modeling, test, operation, optimization, etc. Meanwhile, complex systems, such as transportation system, power system, communication system and other various critical infrastructure systems, have posed a big challenge, which attracts great attention both in theory and application. Characterized by nonlinear interaction, emergent response, and high dimensional coupling, the complex systems are in the face of extremely high uncertainty and vulnerability. Therefore, failure of these complex systems could cause even more dramatic cascading impacts, leading to huge losses of life and property. All these realities put forward more urgent requirements for the fundamental theory and specific application of reliability management of complex systems.

This special issue in *Frontiers of Engineering Management* intends to collect research articles or reviews on "Reliability Management of Complex System", including different aspects of framework, theory, technology and method in the management process for improving the system reliability.

Lu et al. proposed a novel reliability framework to guarantee the ideal operation state of the Sichuan–Tibet Railway. The authors considered the Nine-Connotation (i.e., safety, inherent reliability, testability, maintainability, supportability, environmental adaptability, predictability, resilience, and durability) as the goal of optimizing railway's operational efficiency. On this basis, the authors established a reliability framework consisting of a resilience management system, an integrated technology system, and a dynamic reliability assessment system.

Wang conducted a systematic overview of the advent and evolution of reliability systems engineering (RSE) in China. The author introduced emphatically the latest model-based RSE (MBRSE) development, including establishment of the system architecture and conceptual model, fundamental theory and methodology (with a V-model as the core of this approach). The author also presented the development of various MBRSE platform over the past 30 years and outlined the prospective trends in RSE development in China.

Wu and Li focused on the topic on resilience of Cyber–Physical Power System (CPPS). From the engineering perspective, the authors explained the concept and significance of CPPS resilience, and then expanded this topic to reviewing the assessment measures, optimization methods, and recent modeling advances. In the end, the authors also discussed the future challenges and research directions for CPPS resilience optimizing.

Borrowing the idea from sequential inspections for remaining useful life prediction and accelerated lifetime test, **Hu et al.** proposed a sequential degradation-based burn-in model with multiple periodic inspections. On this basis, the authors cast the problem into a partially observed Markov decision process to minimize the expected total burn-in cost of a product. Their algorithms can effectively identify the joint optimal inspection period and number of inspections in steps.

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Li and Jia conducted a comprehensive overview of the development of reliability metrics for power grid and telecommunication networks. The authors classified the metrics of power grid into the reliability of power distribution and generation/transmission, and the metrics of telecommunication network into connectivity-based, performance-based, and state-based metrics. The difference between the situations of the reliability metrics of the two systems was also discussed in this work.

Bai et al. proposed an improved power grid resilience measure and its corresponding importance measures, which can support the decision-making for quick recovery of power grids after disasters. The recovery priorities of components with different importance measures is found varying.

Given the complexity of traffic health management, a systematic approach focusing on the global traffic status has considerable significance. **Zeng et al.** reviewed existing studies in traffic reliability management, and proposed a health-oriented management target of complex traffic systems, which aims to be "reliable, invulnerable, resilient, potential, and active". On this basis, the authors proposed a traffic health management framework which is composed of modeling, evaluation, diagnosis and improvement.

Duan et al. proposed a general mathematical framework coupling the complex structure of the system with the nonlinear activation function, to explore the decoupled dimension reduction method of high-dimensional system as well as reveal the calculation mechanism of the neural network. The authors found that there exists a simple linear mapping relationship between network structure and network behavior in the neural network with high-dimensional and nonlinear characteristics.

Kang et al. reviewed four critical research areas of risk warning technologies and emergency response mechanisms in railway construction, including risk identification, risk management, emergence response planning and management, and rescue mechanisms. Based on the scenario of Sichuan–Tibet Railway construction, the authors presented four corresponding research areas and recommendations after reviewing the existing studies.

Cheng et al. proposed a robust energy-efficient train speed profile optimization approach for reducing energy consumption in urban rail transit systems. Compared with the existing approaches based on deterministic input parameters, the authors took the uncertainty of train modeling parameters into account. The effectiveness and efficiency of the proposed approach was verified through the collected data of a typical metro line.

Finally, we would like to express our sincere gratitude to all the authors for sharing their impressive insights and innovative ideas on this special issue. We also sincerely thank all the reviewers for their great support and excellent suggestions during the organization of this special issue.

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Ziyou GAO is a professor, as well as a doctoral supervisor, at Beijing Jiaotong University, China, and an expert on traffic and transportation engineering management. He is currently the dean of Institute of Transportation System Science and Engineering at Beijing Jiaotong University, and the president of the Society of Management Science and Engineering of China. He is the former deputy director of Management Science Department of National Natural Science Foundation of China. Prof. Gao received his master's and doctoral degrees from Institute of Applied Mathematics, Chinese Academy of Sciences, in 1988 and 1994, respectively. Prof. Gao presided over some of China's major research projects on urban traffic management, such as the first National Basic Research Program in the field of urban transportation in China — Studies on Traffic Congestion Bottleneck in Big Cities from the Ministry of Science and Technology, and the national innovative research group project — Theories and Methods of Urban Traffic Management from National Natural Science Foundation of China. He established decision optimization methods of urban road traffic management and a new mode of coordinated operation and management of urban rail transit network. Prof. Gao has won second prize of National Natural Science Award, as well as first prize for four times of Natural Science Progress Award at the provincial level.