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ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems

Guest Editorial

Special Section: Modeling and Analysis of Inspection Uncertainties in Structural Health Monitoring

The recent advancements in structural health monitoring technology are truly remarkable [1,2], with the utilization of sophisticated methods, such as finite element analysis [3], mathematical statistics [4], and artificial intelligence [5], for performing thorough analyses. However, despite the wealth of tools at our disposal, uncertainties in mathematical modeling and analysis still hinder achieving accurate and reliable assessments in real-world scenarios. This Special Section issue of the ASCE-ASME *Journal of Risk and Uncertainty in Engineering Systems Part B: Mechanical Engineering* on the Modeling and Analysis of Inspection Uncertainties in Structural Health Monitoring aims to shed light on these critical issues and explore avenues for future research and development, which contains eight technical papers.

Gao et al. use numerical simulation methods to systematically study the dynamic performance of high-speed rail bridges in cold regions. By analyzing the coupled vibration of the axle and vehicle during the freeze-thaw cycle, the author discussed the changes in soil composition and the stress characteristics of the pile foundation. Their findings reveal the impact of foundation freezing on the dynamic performance of high-speed trains, providing valuable insight into railway infrastructure design and maintenance.

Liang et al. present a novel method for indirectly predicting spindle rotation error in mechanical processing using vibration signals. By leveraging self-adaptive supervised learning techniques, the research offers a promising approach to fault detection and predictive maintenance in industrial settings, thereby enhancing the efficiency and reliability of machining processes.

Zhang and Zhao propose a linear moment-based method for integrating random variables characterized by unknown cumulative distribution functions into Monte Carlo simulation frameworks. By utilizing statistical moments and simulation techniques, the authors provide a robust approach to structural reliability analysis even when probability distributions are unknown.

Wang et al. develop a comprehensive framework for resilience assessment and optimize a functional recovery model after an earthquake. Through numerical modeling and sensitivity analysis, the authors evaluate the seismic performance of single-column pier bridges and propose mitigation measures to enhance their performance under seismic loading conditions.

Gao et al. investigate the theory and empirical analysis of bridge load limitation, focusing on determining reasonable load limit values for highway bridges under heavy-duty vehicle loads. By combining traffic flow information, structural reliability theory, and empirical validation, the authors propose a method for calculating load limit values that ensures the safety and reliability of bridge structures.

Gao et al. propose an efficient method for assessing the influence lines of self-anchored suspension bridges by applying deflection theory. Through real-time monitoring and intelligent damage evaluation, the research facilitates the accurate detection of structural abnormalities, offering practical guidance for assessing the capacity of real bridges.

Xu et al. introduce a hybrid vision-based method for estimating structural displacements and leverage Mask Region-Based Convolutional Neural Networks (Mask R-CNNs) to improve the accuracy and reliability of displacement estimation in structural health monitoring applications. By integrating target-based and target-free methods, the research offers a comprehensive approach to monitoring structural behavior with subpixel accuracy.

Cheng et al. propose a target-oriented Krill Herd algorithm to overcome local optima and improve optimization efficiency to address the optimization of discrete truss structures. Through experimental comparisons and performance evaluations, the research demonstrates the efficacy of the proposed method in achieving competitive solutions for structural optimization problems.

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