

CONDITION ASSESSMENT OF BRIDGES USING PHYSICS-BASED AND DATA-DRIVEN METHODS

Speaker

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Abstract

Bridges play a crucial role in the transportation infrastructure network, and their safety is paramount for ensuring traffic functioning and economic development. This presentation aims to introduce the condition assessment of both girder bridges and cable-supported bridges, utilizing both physics-based and data-driven methods.

To assess the health condition of girder bridges, we established a stochastic traffic model based on weigh-in-motion data. Subsequently, reliability analysis is conducted to determine the optimal truck weight limit for an urban bridge network. A condition rating method is developed for highway bridges, leveraging natural language processing (NLP) and machine learning techniques. The method involves establishing a data repository with inspection reports, implementing NLP for textual data processing, and employing ML techniques for condition rating prediction.

For long-span cable-supported bridges, a method is developed to encode original train-passing time series into images for trainload classification. The approach includes image preprocessing, Histogram of Oriented Gradients (HOG) feature extraction, and SVM-based classification. Additionally, machine learning-based methodologies are then developed to estimate fatigue damage in the truss girder of suspension bridges.

By combining physics-based understanding with data-driven methodologies, we can enhance the efficient evaluation of load capacity and condition assessment of bridges, ultimately supporting the intelligent management of bridge infrastructure.

Biography

Zhen Sun is a professor in the School of Civil Engineering, Southeast University, Nanjing, China. His main research interests include structural health monitoring, machine learning-based condition assessment, damage detection, and load carrying capacity evaluation of bridges. He published over 40 refereed journal articles with an H index of 22. He also holds 8 registered invention patents, and has participated in 4 standards/codes related to structural health monitoring of bridges. He has been involved in condition assessment and load carrying capacity evaluation of several long-span bridges, such as Jiangyin Suspension Bridge, Sutong Cable-stayed Bridge, and the April 25th Suspension Bridge.

He serves as editorial board member of Data in Brief (Elsevier, Impact factor: 1.2), a guest editor for special issues in Structural Control and Health Monitoring, Engineering Structures, Engineering Failure Analysis.



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