Validation and Updating of Regional Bridge Deterioration Model Incorporating Structural Health Monitoring

Xiaoming Lei, Ye Xia
Tongji University, Shanghai, China

Limin Sun
State Key Laboratory of Disaster Reduction in Civil Engineering, Tongji University, Shanghai, China

Contact: leixiaoming@outlook.com

Abstract
Civil infrastructure has aided economic development and social progress. Existing reinforced concrete beam bridges undoubtedly suffer the damages due to loads, structural defects, etc. To increase the accuracy of safety assessments, a reliable bridge deterioration model is required. This study presents a technique for validating and updating the regional bridge deterioration model by using monitoring data from a few bridges in the area. This method avoids data-level fusion and instead employs model-level fusion. In model validation, it makes full use of the depth of individual bridge monitoring data as well as the breadth of bridge group inspection data. The suggested method is validated in a case study including regional bridges in Northern China. When the number of monitored individual bridges grows, the validation and correction of the regional bridge deterioration model will be more effective.

Keywords: deterioration model; regional bridges; inspection data; structural health monitoring; model updating; condition assessment.

1 Introduction
In recent decades, huge expansions in civil infrastructure have supported economic growth and social advancement. China, the United States, Europe, and other areas have large in-service bridge holdings, and a great number of bridges are classed as damaged, posing a possible safety risk to the serviceability of local transportation networks [1]. Simultaneously, the vast amount of regional bridge inspection and monitoring data generated over time contains some structural performance-related information [2]. As a result, it is essential to generate a credible bridge deterioration model.

In general, the regional bridge deterioration model is generated from years of visual inspection reports. Although the regional bridge database consisting of bridge structural inspection data has been pre-processed with data cleaning and reconstruction techniques [3], it still consist of some errors that may misguide the deterioration model generation. Structural health monitoring is a more reliable and objective way to acquire in-service data that reflect the condition on measured structures, but the huge costs of structural health monitoring systems prevent their installations on every bridge.

Previous studies have proposed some methods to take advantages of inspection and structural health...