Sensitivity Analysis of Missing Data Imputation Methods for Reliable Bridge Condition Assessment

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ABSTRACT

Incomplete bridge inspection records containing missing information of bridge defects are inevitable due to sensor failures or bridge engineers' omission errors during field inspections. Such incomplete inspection data could bias the condition assessment and mislead the maintenance decisions that lead to structural safety risks and raise maintenance costs. Existing studies proposed data imputation methods for filling in the missing values based on their spatiotemporally adjacent data. Unfortunately, these studies spent little effort examining the impacts of missing and imputed data on the reliability of bridge condition assessments and maintenance decisions. Biases within condition assessment and maintenance decisions can either waste maintenance resources or miss the chances of preventing structural failures. This paper uses sensitivity analysis to comprehend and explain missing data and data imputation methods' influences on bridge condition assessments' reliability. Such sensitivity analysis results could provide a basis for choosing data imputation methods that would not cause condition assessment biases and guiding data collection efforts to focus on safety-critical data sets.