Bayesian Approaches For Estimation Of Suspension Bridge Deflection Variation Under Thermal Affection

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Long-span bridge deflection is a significant structural safety index for structural performance evaluation, however, its accurate estimation is greatly influenced by thermal actions. The main objective of this study is to investigate the variability of the bridge deflection (including bridge girder and main cable) under thermal actions. Two Bayesian approaches, Bayesian generalized linear model (BGLM) and sparse Bayesian learning (SBL), are proposed to characterize the correlation between the structural temperature and the bridge deflection by use of the long-term structural health monitoring (SHM) data. They are fully model-free data-driven approaches, preferable for reckoning the temperature-induced bridge deflection for structural performance assessment. With monitored displacement responses and temperatures, two Bayesian models (a BGLM and a SBL model) are firstly developed for characterizing the relationship of bridge deflection to temperature, and their prediction performances are compared to determine the quality of the two models. Then a Bayesian factor is formulated to evaluate the structural health condition when newly collected monitoring data are available and to provide damage alarm once the probability of damage exceeds a certain threshold. In the case study, filed monitoring data acquired from a long-span suspension bridge are used to illustrate the proposed approach, including examining the bridge deflection under the extreme temperatures.