

Data-driven pattern recognition in structural health monitoring

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【Background】

In long-term SHM, there are two issues affecting the reliability of anomaly detection. One is the uncertainty in each observation of damage indicators, while the other is the effect of environmental and operational variability (EOV) in time history. How to confirm the structural health state in long-term SHM under the interference of these two issues is of great value to discuss.

【Objective】

This study aims to investigate and make some strategies for anomaly detection considering the influence of identification uncertainty and effect of EOV in long-term SHM.

By data-driven methods utilizing the correlation, autocorrelation, co-integration or subspace properties, some invariant structure are expected to be extracted and used for anomaly detection from the long-term variation of damage sensitive features (DSFs) like modal frequency, strain, displacement, etc.

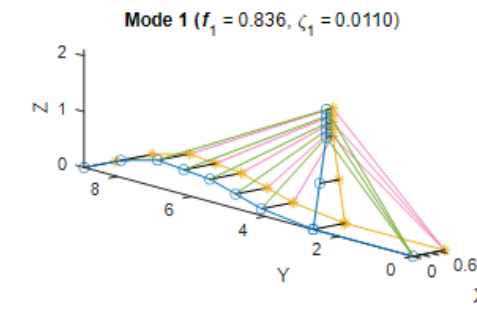
【Approach】

The effect of identification uncertainty and EOV is considered in two perspectives. On one hand, the global variability involving these two parts is quantified and compared with FEM simulated damage effect. On the other, study on extraction and reduction of the effect of EOV is conducted by temperature-driven model and the spatial /- temporal structure of DSFs. Both perspectives offers meaningful results in the case study.

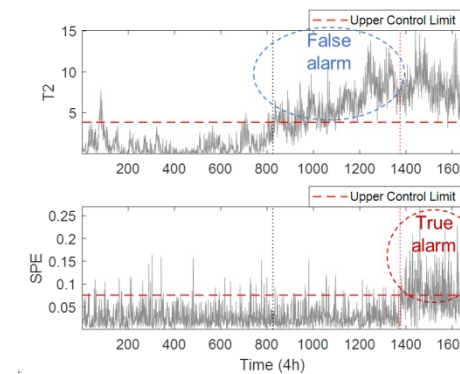
【Publication plan】

- A journal paper about BAYOMA and cable tension estimation in cable-stayed bridge is in preparation.

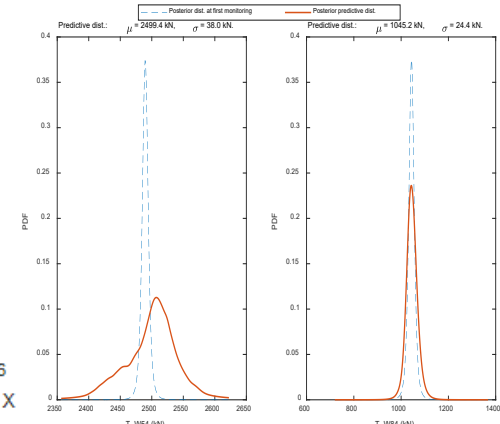
【Results】



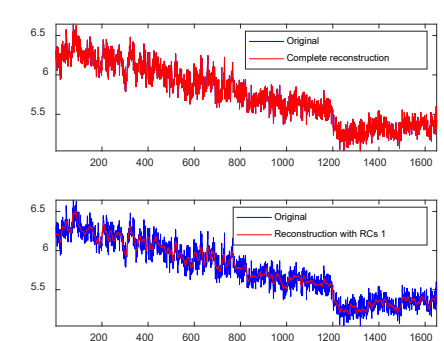
(a) Bayesian OMA



(c) Control chart of PCA-based MSPC



(b) Posterior predictive distribution



(d) SSA-based trend extraction