Data-driven pattern recognition in long-term SHM with the effect of EOVs

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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 variations (EOVs) 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 EOVs 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 EOVs 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 EOVs is conducted by temperature-driven Gaussian mixture model in the DSFs , and a conditional NLLF-based anomaly detection method is proposed.
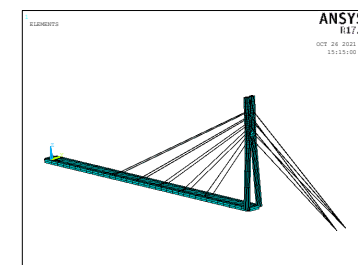
【Publication plan】

・A journal paper about BAYOMA and cable tension estimation in cable-stayed bridge is in preparation.
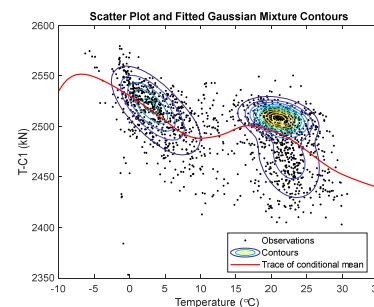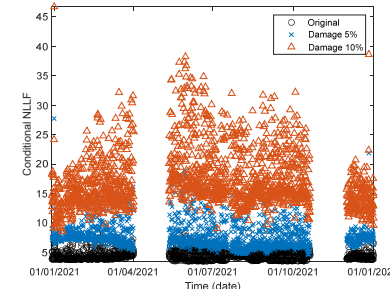
【Results】
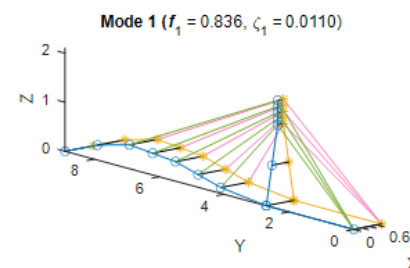
(a) Bayesian OMA.

(b) FEM updated by PSO.

(c) Fitted GMM for cable C1.

(d) Anomaly detection with conditional NLLF.