Uncertainty quantification for monitoring of civil structures from vibration measurements

Michael Döhler, Laurent Mevel

Uncertainty Quantification for Monitoring of Civil Structures from Vibration Measurements

Michael Döhler, Laurent Mevel

Inria, Campus de Beaulieu, 35042 Rennes, France

Health Monitoring of civil structures can be performed by detecting changes in the modal parameters of a structure, or more directly in the measured vibration signals. For a continuous monitoring the excitation of a structure is usually ambient, thus unknown and assumed to be noise. Hence, all estimates from the vibration measurements are realizations of random variables with inherent uncertainty due to (unknown) process and measurement noise and finite data length. In this talk, a strategy for quantifying the uncertainties of modal parameter estimates from a subspace-based system identification approach is presented and the importance of uncertainty quantification in monitoring approaches is shown. Furthermore, a damage detection method is presented, which is based on the direct comparison of the measured vibration signals without estimating modal parameters, while taking the statistical uncertainty in the signals correctly into account. The usefulness of both strategies is illustrated on data from a progressive damage action on a prestressed concrete bridge.

References

[1] E. Carden and P. Fanning. Vibration based condition monitoring: a review. *Structural Health Monitoring*, 3(4):355-377, 2004.

[2] M. Döhler and L. Mevel. Efficient multi-order uncertainty computation for stochastic subspace identification. *Mechanical Systems and Signal Processing*, 38(2):346-366, 2013.

[3] M. Döhler, L. Mevel, and F. Hille. Subspace-based damage detection under changes in the ambient excitation statistics. *Mechanical Systems and Signal Processing*, 45(1):207-224, 2014.