State-parameter estimation and optimal input/output locations for monitoring of structural dynamic systems

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ABSTRACT: The seminar will focus on vibration-based identification and monitoring of structural systems. We will start with the joint state-parameter estimation problem for nonlinear dynamic systems. The unscented Kalman filter, a popular estimation technique, will be discussed, along with variants, which provide improved convergence characteristics through the ability to handle constraints on the states/parameters. Example applications on hysteretic, linear time-varying and rocking systems, will be presented.

As the success of any identification exercise will depend on the measured data, in the next part of the seminar, we will focus on the determination of instrumentation set-ups to provide the most informative data. Methods based on maximizing the associated Fisher information will be discussed. The issue of parameter identifiability will also be considered, along with some tests for identifiability given any sensor set-up. Example applications, illustrating the effect of input/output locations on parameter identifiability, on uncertainty in parameter estimates, and on damage assessment using such estimates, will be presented.