Nonlinear system identification from noisy measurements

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Abstract: A novel nonlinear system identification procedure using noisy measurements for health assessment of real civil infrastructure systems is presented. The important features of the procedure are that it can identify a structural system using only a limited number of highly noise-contaminated responses measured for a very short duration. To compensate for the use of very short duration response time-histories, multiple weighted global iteration (WGI) procedure is introduced in the unscented Kalman filter (UKF) algorithm to help the convergence process. It is denoted as UKF-WGI procedure. The algorithm is a finite element-based nonlinear system identification technique. It identifies not only the integrity of the whole structure, but also the locations and severity of the defects. Since no similar studies are reported in the literature, the superiority of UKF-WGI over the extended Kalman filter-based procedure in the presence of noise is established with the help of several illustrative examples.

Keywords: nonlinear system identification; structural health assessment; damage detection; unscented Kalman filter; UKF; extended Kalman filter; EKF; finite element; noisy measurement.

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