
Structural health assessment using extended and unscented Kalman filters

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Abstract: Structural health assessment procedures using extended and unscented Kalman filter concepts are presented and compared. The extended Kalman filter (EKF)-based algorithm proposed earlier for nonlinear system identification comes with limitations. The linearisation process used in EKF may lead to non-convergence for higher level of nonlinearity. To address the deficiency, the authors proposed a new algorithm known as unscented Kalman filter with unknown input and weighted global iteration (UKF-UI-WGI). In this study, a weighted global iteration technique with objective function is incorporated with the UKF algorithm in order to improve its efficiency. To generate the information required to implement the algorithm, it is integrated with least-squares-based algorithm. The stability, convergence, and robustness of the UKF-UI-WGI over EKF-based algorithm are compared in terms of several parameters including the sampling interval, duration of responses, and the dimension of the frames. With the help of examples, the overall superiority of UKF-UI-WGI over EKF-based algorithm is established.

Keywords: structural health assessment; SHA; damage detection; nonlinear system identification; extended Kalman filter; EKF; unscented Kalman filter; UKF.

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