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Extension of the Generalized Unknown Input Kalman Filter for Online-Reconstruction of External Structural Loads

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External load information is of great interest in structural health monitoring (SHM), since it can help to evaluate possible damage of a structure due to fatigue loading or after extreme events. However, some loads might not be measured directly and have to be reconstructed from structural response measurements. This is a type of ill-posed inverse problem where small perturbation of the measurements may cause unstable solutions. Therefore, a robust load reconstruction strategy is needed.

In this paper, an extension of the generalized Kalman filter with unknown inputs method, G-KF-UKI (Generalized Kalman Filter with Unknown and Known Inputs), is proposed. This method can realize online input force estimation and is robust to modeling errors and measurement noise. Besides this, the presented G-KF-UKI strategy also includes known inputs (e.g. control inputs or known force inputs), which makes it applicable to a larger class of systems. An experiment on a laboratory two-storey structure and a simulation study on wind load reconstruction are given as examples to show the effectiveness of this method.

Ключевые слова:

Содержание.