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Parametric Identification of Structures with Unknown Excitations using Quadratic Sum-squares Error with AR Model

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ABSTRACT
Time domain analysis methodologies based on measured vibration data have been studied and shown to be useful for the on-line system identification of structures, such as the least square estimation (LSE), the extended Kalman filter (EKF), the sequential nonlinear LSE (SNLSE), and the quadratic sum-squares error (QSSE). These approaches have also been extended to cover the general case where some of the external excitations are not measured or not available. However, when applying the above approaches, an extended unknown vector has to be formed consisting of both the unknown structural parameters and the unknown excitations. The time-varying feature of this extended vector leads to a relative complicated derivation of its recursive solution and consequently makes it difficult to apply in real engineering practice. Thus, in this paper, a new approach based on the basic concept of QSSE method and AR model will be proposed, referred to as the QSSE-AR approach, aiming to reduce the computational efforts involving in the estimation of unknown structural parameters and unmeasured external excitations. Analytical recursive solutions of the proposed QSSE-AR approach will be derived and presented. Simulation studies will be carried out to verify the accuracy and effectiveness of the proposed QSSE-AR approach in identifying structural parameters as well as the unknown excitations of both linear and nonlinear structures.

KEYWORDS: *Online system identification, time domain analysis, quadratic sum-squares error, analytical recursive solutions*