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Basis Function Selection Criterion for Modal Monitoring of Non Stationary Systems

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ABSTRACT

Functional Series Time-Varying Autoregressive parametric methods have been successfully used in many engineering applications for identification of modal parameters from output-only and non-stationary vibration signals. The basis function approach seems efficient in dealing with online data using autoregressive technique. In this approach, the deterministic model parameters are estimated through a set of linearly independent basis functions such as Legendre, Chebyshev, Walsh, Wavelet and others. In most of applications, a-priori knowledge of the signal is not available and the selection of the basis function is rather empirical and casual. Such lack of rules in choosing basis function affects consequently the results of model parameter estimation and modal identification. Therefore, a criterion which serves as a guideline in selecting basis functions becomes necessary in order to improve the methods. In this paper, we introduce such a criterion called Basis Function Selection Criterion which is based on the minimization of the difference between the model parameters estimated by two methods, namely FS-VTAR and the classic stationary VAR. FS-VTAR uses a family of basis functions whereas the second method is based on an approximation of a non-stationary process as stationary one in a short time segment for model parameter estimation. In this work, a non-stationary vibration system is numerically simulated and the signal is processed in FS-VTAR using the proposed BFSC. This numerical experimentation showed very promising results in both the estimation of FS-VTAR model parameters and the identification of the modal parameters of the non-stationary system.