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Operational Modal Analysis in the Presence of Several Powerful Harmonic Excitations, Rotating Machinery Application

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Abstract

Operational Modal Analysis (OMA) is an efficient and useful technique for extracting modal parameters of structures. In OMA only the response to the ambient forces in normal working conditions are used. Due to the assumption of stochastic input forces, OMA methods have many limitations and difficulties in the presence of harmonic excitations. Many researchers adapted OMA methods to consider presence of harmonic excitations. Nevertheless, in a rotary machine, several powerful harmonic excitations superimposed to the stochastic forces and most of the OMA methods will fail in that case. In this paper, the Curve-Fitted Enhanced Frequency Domain Decomposition (CFDD) method is used for OMA of rotating machineries. CFDD method is a robust technique to harmonic excitation in OMA. In this method, modal parameters are estimated using curve-fitting in frequency domain. An estimation of SDOF frequency response function is used to extract modal parameters via curve-fitting in full frequency band and the harmonic components are removed by linear interpolation in SVD graph. Using the entire frequency band to form regression problem causes extra computation. Also using linear interpolation may cause error in extracted modal parameters especially if a harmonic peak coincides with a structural natural frequency. In this paper modified CFDD method is presented by two modifications. The first modification is using limited data in the vicinity of each mode to form regression problem. The second modification is to eliminate the frequency lines corresponding to harmonic components instead of linear interpolation. The applicability of the new method is evaluated by modal parameter extraction of a large industrial fan in Mobarakeh Steel Complex using the response of fan in its normal operation.

Keywords: Operational modal analysis; Harmonic excitation; Rotating machinery.