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Identification of Structural Parameters Using Combined Power Flow and Acceleration Approach in a Substructure

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Abstract

This paper presents the application of a power flow parameter to improve system identification results when used along with conventional acceleration matching techniques. In this paper the power balance concept is implemented in a substructure to estimate the stiffness and damping coefficients from time domain responses. Power flows are calculated using the time averaged product of force and velocity at the input and substructure interfaces of a substructure. The concept of power flow balance through the substructures is to equate the input power against the dissipated and transmitted powers and by reducing any imbalance to zero using optimization methods. No extra sensors are needed to include criteria of power flow balance along with acceleration matching. Numerical simulations are performed for substructures from a 10 degree-of-freedom (DOF) lumped mass system, a planar truss of 55 elements with 44 DOF and a cantilever beam of 20 elements to evaluate the feasibility of the proposed method. In numerical simulations, noise free and noise contaminated response measurements are considered. The Particle Swarm approach is used as the Optimization algorithm, and the fitness function is defined to minimize the error with weighted aggregation multi-objective optimization (MO) technique. The results demonstrate that the proposed combined method is more accurate in identifying the structural parameters of a system compared to conventional acceleration based matching methods.

Keywords: power flow, substructure, system identification, structural response, time domain

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