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ENERGY SENSITIVITY BASED METHOD FOR STATISTICAL ENERGY ANALYSIS PARAMETERS IDENTIFICATION

Abstract

The Statistical Energy Analysis (SEA) has currently been widely recognized as a method of high frequency vibration analysis for aerospace structures. However, numerous difficulties may be encountered for SEA modeling of complex structure due to the theoretical assumptions and especially the essential proper estimate of SEA parameters. The experimental SEA techniques can be used to significantly enhance the analytical procedures. An acknowledged one of these techniques is the power injection method (PIM), which requires yet exciting every single subsystem sequentially and measuring the input power and energy levels of every subsystem completely. This paper aims at identifying SEA parameters from experimental data that is incompletely excited and measured. An energy-sensitivity-based SEA parameters adjusting scheme using the Levenberg–Marquardt algorithm is developed. The objective of the methodology is to minimize the residuals between measured and theoretical predicted energy levels. Since the energy sensitivities with respect to the selected damping loss factor and coupling loss factor have been computed, the improved parameters estimate is determined iteratively by solving a nonlinear constrained optimization problem. In addition, a series of formulas of error sensitivity are derived from energy sensitivity to assess the accuracy of the SEA parameters with the confidence levels of measured data and analytical SEA parameters which are not selected for adjusting. The methodology is validated through simulated data of two numerical SEA models. Also, an experimental investigation of a two-plate structure is carried out. The SEA parameters are successfully identified from the test data of one excited subsystem and two measured ones, which indicates that the methodology has the potential to be implemented in a complex structure.