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Passive Vibration Isolation Analysis and Optimization for Mechanical Systems

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Abstract : Vibration is an important issue in the design of various components of aerospace, marine and vehicular applications. In order not to lose the components' function and operational performance, vibration isolation design involving the optimum isolator properties selection and isolator positioning processes appear to be a critical study. Knowing the growing need for the vibration isolation system design, this paper aims to present two types of software capable of implementing modal analysis, response analysis for both random and harmonic types of excitations, static deflection analysis, Monte Carlo simulations in addition to study of parameter and location optimization for different types of isolation problem scenarios. Investigating the literature, there is no such study developing a software-based tool that is capable of implementing all those analysis, simulation and optimization studies in one platform simultaneously. In this paper, the theoretical system model is generated for a 6-DOF rigid body. The vibration isolation system of any mechanical structure is able to be optimized using hybrid method involving both global search and gradient-based methods. Defining the optimization design variables, different types of optimization scenarios are listed in detail. Being aware of the need for a user friendly vibration isolation problem solver, two types of graphical user interfaces (GUIs) are prepared and verified using a commercial finite element analysis program, Ansys Workbench 14.0. Using the analysis and optimization capabilities of those GUIs, a real application used in an air-platform is also presented as a case study at the end of the paper.

Keywords : hybrid optimization, Monte Carlo simulation, multi-degree-of-freedom system, parameter optimization, location optimization, passive vibration isolation analysis

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