METHODOLOGIES FOR DETERMINISTIC AND PROBABILISTIC OPTIMIZATION IN NVH USING RE-ANALYSIS

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ABSTRACT – Deterministic and probabilistic design optimization for NVH performance requires repeated finite-element analyses of large models which are computationally expensive. This paper presents various methodologies for deterministic and probabilistic design optimization of large-scale structures using two classes of re-analysis methods; one for estimating the deterministic vibratory response and another for estimating the probability of the response exceeding a certain level. The latter can be used to obtain an optimal design which is insensitive to manufacturing tolerances and/or lack of information (robust design), and simultaneously meets all performance targets even in the presence of variation (reliable design). Emphasis is put on accuracy and computational efficiency in order to have an accurate design tool for realistic large-scale models which can be efficiently used in vehicle development. The deterministic re-analysis method can analyze efficiently large-scale finite element models consisting of millions of degrees of freedom and many design variables that vary in a wide range. The probabilistic re-analysis method calculates very efficiently the system response under uncertainty by performing a single Monte Carlo (MC) simulation of one design. Due to the multi-modal behaviour of vibratory systems, a hybrid optimization scheme is used. It starts with a genetic algorithm in order to explore the entire design space quickly, and then switches to a gradient-based optimizer which refines the optimal design. Realistic vehicle finite-element models are used to demonstrate the efficiency and accuracy of the optimization methodologies and highlight their capabilities.