RANDOM RESPONSE & FATIGUE OPTIMIZATION IN THE FREQUENCY DOMAIN

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ABSTRACT

Frequency based methods for random response and fatigue are becoming more widely used in the automotive industry. The use of PSD's (Power Spectral Densities) coupled with system properties in the frequency domain (transfer functions) offer significant benefits over time based approaches in terms of analysis time, model sizes that can be handled, and advanced diagnostic information available to improve the designs. Most importantly, such methods facilitate the incorporation of optimization techniques in the product development cycle to find the optimal values for parameters such as part thicknesses, material properties for reduced weight and improved design life.

However, even with analysis methods that provide affordable solution times for large system models, engineers and designers do not yet explore the full potential of optimization. Process automation that is required to conduct optimization studies can be daunting for several reasons. The design simulation process is usually not comprised of only one solver execution but includes several solvers. In addition to solvers, the engineer needs to automate parametrization and response extraction. While dealing with even faster-to-design cycles than before, engineers don't always have the time to develop connections for all the tools required and incorporate it in their design process. The bandwidth to learn the technology can also be another challenge. In order to facilitate the transition from trial and error process to design exploration and optimization, the tools that make up the analysis process needs to communicate with

each other seamlessly and offer powerful optimization methods that are also highly usable by engineers.

In this paper, application of frequency based methods for random response and fatigue optimization is demonstrated on an automotive full body system. The virtual durability process followed uses MotionSolve for multi-body simulation to generate body loads and OptiStruct for finite element analysis to compute stress states as input to frequency-based fatigue analysis using CAEfatigue. The process is automated and executed for optimization in HyperStudy and the results are then post processed using HyperView. This process is setup and executed within a work week due to the existing integrations between the products and usability of optimization methods in HyperStudy, specifically Global Response Surface Method. Using the process outlined, it is feasible to achieve considerable weight reduction while maintaining desired fatigue life within a typical project timeline.