Design optimization with Modal Assurance Criteria (MAC)

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Abstract

Simulation-based optimization is one of the efficient tools for product design optimization. This paper introduces the application example of modal analysis with LS-DYNA® and mode tracking of LS-OPT® , to improve the body stiffness. The mode tracking is a powerful tool to track a specific mode by evaluating the scalar MAC value even if the sequence of modes is changed due to the modification of the design variables by the optimizer. For the connection in the car body model, adhesive bonding is included as well as spot welding.

Design Optimization of Crash Box with Adhesive bonding

In this paper, we introduce a MDO (multidisciplinary design optimization) process of a crash box with adhesive bonding to obtain the optimal amount and position of glue lines. The cash box is modeled as 2 hat structures assembled with spotwelds, and cohesive elements are applied between spotwelds. Figure 1 shows the flowchart of the optimization process. The design variables are the length of cohesive areas. In the process of "CreateADH" Stage, cohesive elements with specified length are automatically generated using "Connection" function of Oasys PRIMER.

In the following Stages "Crash" and "NVH", different kinds of LS-DYNA simulations, which are eigenvalue analysis and explicit crash analysis, are performed for the same crash box model with adhesive bonding.

In "NVH" Stage, we focus on the eigenfrequency of the first torsional mode. A Mode Tracking algorithm is introduced, since the sequence of modes can be altered due to structural changes.

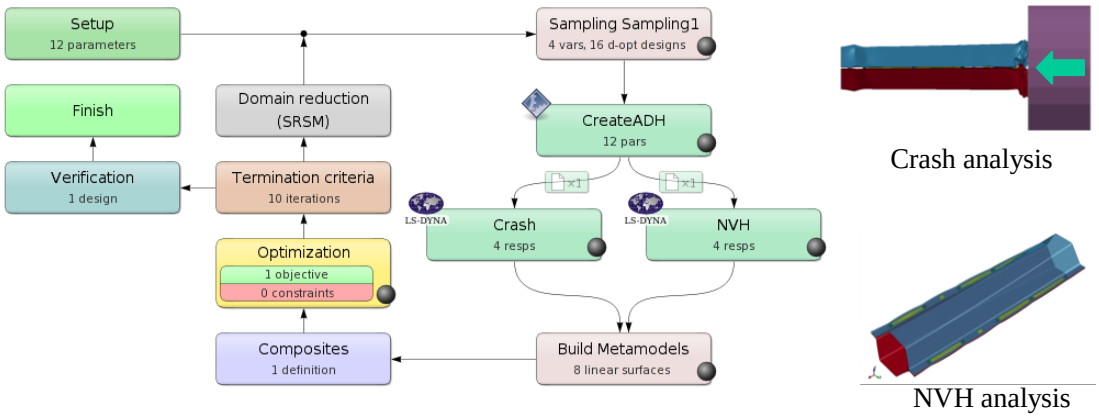

Figure 1: Flowchart of Design Optimization of Crash Box with Adhesive bonding