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Sizing Optimization for Industrial Applications

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Abstract

The current work presents the use of sizing optimization for large scale industrial applications with multiphysics phenomena. Presented are some examples which include either structural-acoustic or thermal-structural coupling. Moreover, these incorporate advanced simulation features such as contact modelling and efficient equation solvers dedicated to handle such large models.

This is achieved using the optimization system SIMULIA Tosca Structure as a direct add-on module for Abaqus. This module targets the thickness layout of the different structural sheet components for optimizing the static or dynamic responses of the structure computed using the users' existing Abaqus workflows.

Traditional design responses such as static stiffness, mass, internal and reaction forces and modal eigenfrequencies can be selected for both the objective function and constraints allowing the optimization of typical engineering setups where the shell thicknesses are the primary design variables.

Sizing optimization is a powerful tool for efficient structural design, being already employed across several industries to systematically achieve structure configurations with competitive performance and reduced design times.

The potential of this technology is here illustrated using some large applications from different industries, including a full automotive model from the transportation and mobility sector and a jacket offshore structure for wind turbines from the renewable energy sector. These represent some typical engineering sizing optimization setups of multiphysics and multidisciplinary problems like fully coupled acoustic structural interaction for NVH (Noise, Vibration and Harshness) design or thermo-structural coupling for designing high temperature components. Furthermore, the work demonstrates how sizing optimization benefits from advanced finite element modelling capabilities such as the support for contact inside or outside the design elements and approaches to handle large models with increased numerical efficiency, for instance the automatic multi-level substructuring eigenfrequency solver (AMS) introduced in Abaqus.

Keywords: industrial applications; sizing optimization; structural optimization software.