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Innovative Engineering Curricula and University Design Competition Applications of Altair OptiStruct and HyperStudy Structural Optimization CAE Tools

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Abstract
The application of advanced structural optimization CAE tools to university classroom instruction and student design team competition can be enhanced by developing CAE tool interfaces which are easily comprehended and student tutorials which are readily accessible and complete. During the last several years the Global Academic Program of Altair Inc has made great strides in offering a variety of on-line learning tools for its OptiStruct and HyperStudy optimization modules. This paper illustrates the effectiveness of these offerings by briefly summarizing the capabilities of OptiStruct and HyperStudy, illustrating the application of these tools by university competition design teams and by university design optimization courses, and describing the development of simplified learning module interfaces and robust on-line student tutorials.

The structural optimization modules of Altair's HyperWorks suite of CAE tools-OptiStruct and HyperStudy-offer extensive capabilities for student learning of concept design synthesis and multi-disciplinary optimization. OptiStruct is capable of conducting four types of structural optimization-topological, topographical, size, and shape- for isotropic and laminated, orthotropic composite structures. HyperStudy is capable of solving multi-disciplinary and multi-objective optimization problems and completing robust design assessment.
The application of these optimization technologies to university design competition teams and student instruction is illustrated in this paper by presenting case studies-two for competitive team design and two for design optimization courses. The first design team application is for the World Solar Challenge-a 3,000 km race through the Australian outback. The University of Michigan-Ann Arbor team utilized OptiStruct to reduce the weight of their current carbon composite race car design by 90 kg from their previous design. The second design team case study is for the Shell Eco-Marathon Competition. The team from Coventry University applied OptiStruct to fully optimize a composite monocoque design while comprehending CFD loads and manufacturing constraints.

The first curriculum example is from the Northwestern University undergraduate-level class: Computational Methods for Engineering Design (ME 341). This course provides an introduction to engineering optimization and promotes project-based learning. Project results related to the optimization of a bicycle crank set and topology optimization of a boom-lever will be discussed. The second curriculum application is from the Michigan Technological University undergraduate-level class: Enterprise Applications of Composite Material Design. This year-long composite materials design course focuses on applying optimization technology to the design of industrial and commercial composite material products. Application of shape and size optimization to the development of student tutorials based on the design of a fiberglass wake board will be illustrated.

The final topic addressed by this paper is the implementation of simplified graphic user interfaces (GUIs) for structural optimization instruction and corresponding tutorials to enhance student understanding of structural optimization concepts. The development of a HyperWorks Student Edition with a simplified user interface and the release of the optimization-focused Inspire module of Altair's SoildThinking CAD program are examples of simplified GUIs available for student usage. On-line tutorials have also been developed for beginning optimization students and more advanced curricula applications. Examples are presented from Altair's on-line Academic Training Center. These include a Student Starter Kit Optimization module and a detailed, step-by-step tutorial on the optimization of an SAE Formula Student Composite Monocoque Design.
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