MAE Seminar SERIES

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3:30 PM

114 HOCHSTETTER

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DESIGN OF CELLULAR STRUCTURES FOR CRASHWORTHINESS

ABSTRACT

This talk presents a structural optimization method for the design of cellular structures subjected to crushing dynamic load. The proposed method integrates three sequential steps. The first step is the generation of a conceptual design using a bioinspired design algorithm referred to as hybrid cellular automaton (HCA). This algorithm mimics processes of structural adaptation that occur in biological structures such as bone. The second step is the dimension reduction of the conceptual design via cluster analysis. To this end, a cluster validity index (CVI) for structural optimization is proposed and maximized. The third step optimizes the cellular structure within each cluster using homogenization methods. In this work, two homogenization methods are utilized energy-based homogenization for linear and nonlinear elastic material models and mean-field homogenization for (fully) nonlinear material models. The proposed methodology is demonstrated through the design of several cellular structures for crashworthiness that include linear, geometrically nonlinear, and nonlinear models.

BIO SKETCH

Andres Tovar, Ph.D. is an Associate Professor of Mechanical and Energy Engineering and an Adjunct Assistant Professor of Biomedical Engineering at Indiana University-Purdue University Indianapolis (IUPUI). He received his B.S. in Mechanical Engineering and M.S. in Industrial Automation from the National University of Colombia in 1995 and 2000, respectively. He earned his M.S. and Ph.D. in Mechanical Engineering from the University of Notre Dame in 2004 and 2005, respectively. At IUPUI, he has been the recipient of the 2015 Wisner-Stoelk Outstanding Faculty Award and the 2016 IU Trustees Teaching Award. He also received the 2014 SAE Ralph R. Teetor Educational Award, the First Place in the 2015 ARPA-E LITECAR Challenge, and the 2018 SHPE STAR Educator of the Year Award. He is the director of the Engineering Design Research Lab and the Center for Additive Manufacturing Research at IUPUI. His research areas include bioinspired design, multiscale topology optimization, and design for additive manufacturing.

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