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Design for Discovery: Structural Shape & Topology Optimization with a Level Set Approach

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Abstract: Topology optimization is an optimization-driven methodology which is capable of generating an optimal design without depending on the designers’ intuition, experience and inspiration. Topology optimization plays a crucial and rapidly expanding role in conceptual design and innovation, especially in automotive, aerospace and machine industries. In this talk, the speaker will make a brief review of the state of the art and introduce a level-set based topology optimization framework. In the level set framework, the boundary of the design is implicitly represented as the zero level set of a one-higher-dimensional level set function. Embedding the design in one higher dimension allows the flexibility in topological changes such as boundary merging or splitting in the design process, while keeping the boundary of the design clearly defined. After that, the speaker will report some of our recent effort to advance the level-set based topology optimization both in methodology and in applications. Selected topics include a variational distance-regularized parametric level set method, distributed compliant mechanisms synthesis, multi-physics energy harvester design, robust shape and topology optimization (RSTO) under uncertainty, and integrated design and additive manufacturing of heterogeneous mechanical metamaterials.

Biographical Sketch: Professor Shikui Chen is an Assistant Professor at the State University of New York, Stony Brook since 2013. He earned his Ph.D. in mechanical engineering from Northwestern University in 2010. Dr. Chen’s research interests are in the area of predictive science based design optimization, particularly in the fields of structural shape and topology optimization, geometric modeling with level set methods, multiphysics simulation, PDE-constrained optimization, and simulation-based design under uncertainty. His research work has been funded by government and industry grants including National Science Foundation (NSF), University Transportation Research Center (UTRC), Ford Motor Company, Stratasys and SUNY Materials and Advanced Manufacturing Network of Excellence. Dr. Chen is a member of ASME and AIAA. He was the recipient of the ASME Compliant Mechanisms Theory Award in the ASME 31st Mechanisms and Robotics Conference in 2007.

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