College of Engineering
Department of
Mechanical & Industrial Engineering

Sidney E. Fuchs Seminar Series

NSF EPSCoR Consortium for Innovation in Manufacturing and Materials (CIMM) Joint Seminar

3:00-3:50pm, Friday, January 29th, 2016
Frank H. Walk Design Presentation Room

Integration of Innovative Manufacturing Processes, Mechanics and Materials Design for Energy-efficient Distributed Manufacturing

by Jian Cao*

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Manufacturing plays a critical role in sustainability and economy. The future of manufacturing is envisioned to be a mixture of distributed manufacturing and concentrated manufacturing modes. At the Advanced Manufacturing Processes Laboratory at Northwestern, research projects can be summarized in three strategic directions: new rapid processes for low-volume production, predictive modelling for high-volume production, and manufacturing processes enabling high-rate surface engineering for hard materials. This talk will provide an overview about those activities and then focus on a relatively new process and its fundamentals that will enhance energy efficiency and material utilization, i.e., double-sided incremental forming (DSIF). DSIF deforms a piece of flat sheet metal into a three-dimensional form as a result of point-by-point deformation through an active control of two genetic tools, one on each side of the sheet. DSIF eliminates the need for geometric-specific tooling and has shown great process flexibility along with a significant increase in forming limit. These advantages have placed DSIF as an alternative process for satisfying the need for low volume, flexible, and rapid prototyping/production and for lightening the weight of sheet metal parts. Recent advancements in the understanding of the deformation mechanism and process innovations to increase geometrical accuracy and flexibility will be presented.

* Jian Cao received her Ph.D. in Mechanical Engineering from M.I.T. in 1995. Dr. Cao is currently a Professor of Mechanical Engineering, Director of Northwestern Initiative for Manufacturing Science and Innovation, and an Associate Vice President for Research at Northwestern University. She is a member of Technical Advisory Committee of the newly established Digital Manufacturing and Design Institute based in Chicago. She was a co-director of the NSF Summer Institute on Nanomechanics, Nanomaterials and Micro/Nano-manufacturing. During her tenure at Northwestern, she took a one-year leave at General Motors and a two-year leave at the National Science Foundation as a program director. Prof. Cao's major research interests include innovative manufacturing processes and systems, particularly in the area of deformation-based processes and laser ablation processes with recent activities in additive manufacturing. Her research has integrated analytical and numerical simulation methods, control and sensors, and design methodologies to advance manufacturing processes. Current research on flexible dieless forming, micro-forming, laser ablation processes and additive manufacturing has direct impacts on energy-efficient manufacturing, surface engineering and rapid manufacturing. She has published nearly 300 technical articles, including over 130 journal articles, 10 book chapters, and 10 patents.