University of Southern California

DANIEL J. EPSTEIN DEPARTMENT OF
INDUSTRIAL AND SYSTEMS ENGINEERING

EPSTEIN INSTITUTE SEMINAR • ISE 651 SEMINAR

Point-of-Need Manufacturing Processes for Enhancing Energy Efficiency

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ABSTRACT

Manufacturing has enormous opportunities to make transiting and transformative contributions to sustainability. This talk focuses on two technologies and their fundamentals that will enhance energy and material efficiency. These two technologies are: friction/wear reduction via surface texturing and incremental forming for better energy/material utilization. It has been noted that friction/wear consumes about one third of total energy generated. Traditional friction and wear reduction strategies include: reduction of the surface roughness of contact parts, deposition of low friction coatings on the substrate surfaces, and lubrication of the interface. A relatively new approach is the creation of surface texture features in the micro-scale range on the surface of the interface part. Our work has demonstrated that significant tribological improvements for friction reduction are achieved when properly designed dimples are formed on the surface of contacting parts. Methods of producing surface texturing are reviewed, which leads to a very promising process, micro-rolling process. On increasing material efficiency, incremental forming deforms a metal piece point by point through an active control of forming tools. It has shown great process flexibility and a significant increase in forming limit to reduce material consumption. These two advantages have placed this incremental forming process as an alternative process for low volume, flexible and point-of-need production. Recent advancements on the understanding of deformation mechanism and process innovations to increase geometrical accuracy are presented.

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ELECTRICAL ENGINEERING BLDG ROOM 248
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Brief Bio

Jian Cao received her Ph.D. in Mechanical Engineering from M.I.T. in 1995. She is currently a Professor of Mechanical Engineering and of Civil and Environmental Engineering at Northwestern University. 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. Her primary interests are in the mechanics analysis, particularly instability analysis and material characterization in sheet metal forming, design of macro/micro metal forming and composite sheet forming processes. Professor Cao is a Fellow of Society of Manufacturing Engineers, a Fellow of American Society of Mechanical Engineers, and an associate member of the *International Academy for Production Engineering*. Her awards include *NSF CAREER award*, *Society of Automotive Engineers (SAE) Ralph R. Teetor Educational Award*, *Society of Manufacturing Engineers (SME) Outstanding Young Manufacturing Engineer Award*, *the Young Investigator Award from the Japan-US Flexible Automation,* and *the Young Investigator Award from the ASME Applied Mechanics Division.* Professor Cao is an associate editor for the *ASME Journal of Applied Mechanics* and an editor for the International Journal of Precision Engineering and Manufacturing. She is an active member of ASME. Her continuous contribution to the society was recognized by the ASME *Dedicated Service Award*. In addition, Prof. Cao is the President of the *SME* North America Manufacturing Research Institute, and a co-director of the NSF Summer Institute on Nanomechanics, Nanomaterials and Micro/Nano-manufacturing.