KTH SOLID MECHANICS SEMINAR; Thursday, December 17th, 13.15; KTH Solid Mechanics Seminar room

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"On the deformation and failure of Al 6061-t6 at low triaxiality evaluated through multiscale experiments"

Modeling of the inelastic response of metallic materials such as Al 6061-T6 is of significant interest in numerous applications in the aerospace, automobile, and naval industries. These models must encompass the early stages of deformation as well as the later stages leading up to failure. Typical models are based on phenomenological descriptions of the constitutive response during the early stages of deformation, and on micromechanical models of damage nucleation and growth (such as the Gurson model) during the later stages that generate intrinsic softening of the material response. Calibration of these models is typically based on measurements of the macroscopic response of the material and is inherently a nonunique process. While there are numerous investigations that implement such models in simulations, there are very few investigations that provide an experimental evaluation, both of the calibration of the models and of their use in predicting the deformation and failure in structural applications. In this presentation, I will first provide an overview of the experimental efforts that have attempted to provide the underpinnings of such models and their calibration. This will then be followed by a quantitative examination of the underlying deformation and failure mechanisms through a detailed, real-time, multiscale investigation of the deformation and failure processes in Al 6061-T6 under shear dominant loading conditions. Specifically, we utilize an in-situ loading stage in a scanning electron microscope and monitor both the macroscopic response and the local deformation and failure at high spatial resolution. The deformation and microstructural changes leading up to failure within the localized bands are identified, and the strain at the onset of final failure is determined at different triaxiality levels. I will follow this with a description of a hybrid experimental-computational procedure for material modeling. The efficacy of the resulting constitutive and failure models will be demonstrated through two example problems that include nucleation and growth of cracks in complex structural configurations.

Professor Ravi-Chandar received his bachelor's degree in Physics from Bangalore University in 1973; and his diploma in Aeronautical Engineering, with honors, from the Madras Institute of Technology in 1976. He received his MS and Ph.D. in Aeronautics from the California Institute of Technology, in 1977 and 1982. He started his academic career at the University of Houston in 1983, and moved to The University of Texas at Austin in September 2000 as a Professor in the Department of Aerospace Engineering and Engineering Mechanics. Since 2007 he holds the Temple Foundation Endowed Professorship No. 1. He has also held numerous visiting positions in Europe and India.

Dr. Ravi-Chandar's research interests are in the general area of mechanics of materials. He is well-recognized for his fundamental work on mechanisms and mechanics of deformation and failure. He has published more than 150 archival journal articles on fracture, instabilities, fragmentation, and authored a book titled Dynamic Fracture.

He is the Editor-in-Chief of the International Journal of Fracture. He has served on numerous professional organizations: member of the US National Committee on Theoretical and Applied Mechanics (2003-present); member of the Congress Committee of the International Union of Theoretical and Applied Mechanics (2010-2018); President of the American Academy of Mechanics (2010-2012); and President of the International Congress on Fracture (2009-2013).

He is a fellow of the ASME, the Society for Experimental Mechanics, and the American Academy of Mechanics and an Honorary Fellow of the International Congress on Fracture. He received the Murray Medal from the Society for Experimental Mechanics in 2004 and the Drucker Medal for the American Society of Mechanical Engineers in 2015.