# SMU Department of Mechanical Engineering

# SEMINAR

## *"Prediction of Ductile Fracture Surface Roughness"*

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**Friday, September 7, 2012**
**3:00 p.m. – 4:00 p.m.**
**Junkins 110**

**Abstract:** **Experimental observations have shown that the roughness of fracture surfaces exhibit certain characteristic scaling properties. Here, ductile crack growth under mode I, plane strain, small scale yielding conditions is analyzed. Although overall plane strain loading conditions are prescribed, full 3D analyses are carried out to permit modeling of the three dimensional material microstructure and of the resulting three dimensional stress and deformation states that develop in the fracture process region. An elastic-viscoplastic constitutive relation for a progressively cavitating plastic solid is used to model the material. In this constitutive relation, porosity is characterized by a single parameter, the void volume fraction. The stress carrying capacity decreases with increasing void volume fraction and vanishes at a critical value of the void volume fraction creating new free surface. Two populations of second phase particles are represented, large inclusions with low strength, which result in large voids near the crack tip at an early stage, and small second phase particles, which require large strains before cavities nucleate. The larger inclusions are represented discretely, so that a characteristic length scale is introduced, and various three dimensional distributions of the larger particles are considered. The scaling properties of the predicted fracture surfaces are calculated and the results are compared with experimental observations.**

***Joint work with Viggo Tvergaard, The Technical University of Denmark; Elisabeth Bouchaud, ESPCI, Paris, Tech; Laurent Ponson, Universite Pierre et Marie Curie**

**Bio:** **Alan Needleman completed his Ph.D. in Engineering at Harvard University in 1970. He then spent five years in Applied Mathematics at MIT before moving to Brown University where he became Florence Pirce Grant University Professor in 1996. He retired from Brown in June 2009 and is now Professor of Materials Science and Engineering at the University of North Texas. His contributions include the development of a ductile fracture computational methodology, the development of cohesive surface methods for fracture analysis and creation of a framework that enables using discrete dislocation plasticity to solve general boundary value problems. Professor Needleman was awarded a Guggenheim Fellowship in 1977, and is a member of the National Academy of Engineering and of the American Academy of Arts and Sciences. He has been awarded the Prager Medal by the Society of Engineering Science, the Drucker and Timoshenko Medals by the American Society of Mechanical Engineers and has been recognized by ISI as a Highly Cited Author in both the fields of Engineering and Materials Science. Professor Needleman also holds honorary doctorates from the Technical University of Denmark and Ecole Normale Superior de Cachan (France).**