Civil & Environmental ENGINEERING

Mechanical Engineering Carnegie Mellon University

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An Excursion into Potential-Based Cohesive Fracture, Branching and Fragmentation

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This presentation is structured into two parts. The first part is associated to the understanding of fracture and fragmentation processes, which are of fundamental importance to address failure of material and structural systems at various engineering scales. Thus this presentation addresses an integrated multiscale computational environment for simulating spontaneous crack nucleation, initiation, propagation, branching and fragmentation of conventional and advanced materials, e.g. hybrid and functionally graded materials. The fracture criteria adopt a cohesive view of material, in which a finite material strength and work to fracture are included in the constitutive description. Especially noteworthy is the use of a novel, unified, potential-based constitutive model for mixed-mode cohesive fracture. Dynamic fracture processes are investigated using the finite element method with special interface elements and a topological data structure representation, based on topological entities (node, element, vertex, edge and facet), which is capable of accessing adjacency information in time proportional to the number of retrieved entities. The capabilities and shortcomings of the cohesive zone method are discussed from a critical point of view, and illustrated by means of examples. The use of advanced data structures, visualization, and large scale computing for simulating cohesive fracture are also discussed.

The second part of the presentation addresses my vision for mechanics both at the National Science Foundation (NSF) and in the USA.

Glaucio H. Paulino. Prof. Paulino is the "Donald and Elizabeth Willett" Endowed Professor of Engineering at the University of Illinois at Urbana-Champaign (UIUC). He joined the Civil and Environmental Engineering Department (CEE) as an Assistant Professor in 1999, was promoted to Associate Professor in 2001, and to Full Professor in 2005. He is director of the "mechanics of materials" program, and acting director of the "Nano and Biomechanics" program at the National Science Foundation (NSF). His seminal contributions in the area of computational mechanics include development of methodologies to characterize the deformation and fracture behavior of existing and emerging materials and structural systems. His recent work spans topology optimization for large-scale multiscale/multiphysics problems. He has devoted significant efforts to increasing collaborative work between the scientific communities in mechanics and materials from the U.S. and developing countries through a series of workshops funded by the National Science Foundation, including events in Brazil (2002, 2003 and 2004), South Africa (2005) and Argentina (2006). His other honors include appointment as the Burton and Erma Lewis Faculty Scholar (2001), the Xerox Award for Faculty Research (2003), the MTS Visiting Professorship Chair in Geomechanics from the University of Minnesota (2004), the Walter L. Huber Civil Engineering Research Prize (2004) from the American Society of Civil Engineers, Visiting Professor appointments at the University of São Paulo (2004, 2005 and 2008), and election as Chairman of the International Conference on Functionally Graded Materials (FGM 2006). His contributions to the permanent scientific literature include more than 130 scholarly publications in top peer-refereed international journals, and a new book on *The Symmetric Galerkin Boundary Element Method,* which has just been published by Springer-Verlag (2008). He has given many national and international invited, keynote, and plenary lectures, and has been a successful engineering consultant to several private and federal institutions. More information about his research and professional activities can be found at the following url: http://www.ghpaulino.com

Fall 2010 Speaker Series

Glaucio Paulino, University of Illinois at Urbana-Champaign

September 24, 2010   Porter Hall 100

4:30 pm - 5:30 pm
5:30 pm - 6:30 pm

Seminar in Porter Hall 100
Reception in the Tung Au Lab