SEMINARIOS INTERUNIVERSITARIOS MECÁNICA Y MATERIALES

Speaker: Professor Miguel Ortiz

Department of Aeronautics and Mechanical Engineering, California Institute of Technology, USA
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Fecha y hora: 18 de diciembre 2008 a las 9:30 h. (café desde 9:15).
Lugar: Sala Verde, 1ª Planta, E.T.S.I. Caminos, Canales y Puertos, C/Profesor Aranguren, Univ. Politécnica Madrid, Ciudad Universitaria.

Multiscale modeling of materials: Linking microstructure and macroscopic behavior

The material models used in simulations are often a major source of uncertainty in the quantification of performance margins. Traditionally, codes were *baselined* against relevant full-system data and combined with many simplifying assumptions. The resulting empirical models were interpolative in nature and could not reliably be applied outside the range of the calibration data set. Within this context, *Multiscale Modelling of Materials* (MMM) may be viewed as a paradigm for systematically *reducing uncertainty* in simulations involving complex material behavior. The ultimate goal of MMM is to enable the simulation of full-scale systems without empirical parameters or phenomenological relations, i.e., on the sole basis of fundamental theories such as quantum mechanics. The main two strategies in Multiscale Mathematics are: i) *Bottom-up*: Coarse-graining of first-principles descriptions of material behavior; ii) *Top-down*: Informing macroscopic models with physics gleaned from the lower scales. The work-horses among bottom-up approaches are constrained minimization at zero temperature and statistical mechanics at finite temperature. The work-horses among top-down approaches are homogeneization, relaxation, and weak convergence. I plan to illustrate this modeling and analysis framework in the particular area of multiscale modeling of mechanical properties of materials, including strength, fracture and fragmentation. In particular, I plan to highlight how modern concepts from the calculus of variations underlie---explicitly or tacitly---most multiscale, enhanced or enriched finite-element methods; and how notions or relaxation and weak convergence provide a powerful and versatile tool---largely unknown to the engineering community---for understanding the properties and limitations of such finite element methods.

Brief CV of Miguel Ortiz

Miguel Ortiz is internationally recognized for his contributions in the fields of mechanics of materials and computational solid mechanics. He is a Fellow and an elected member-at large of the US Association for Computational Mechanics; an elected Fellow of the American Academy of Arts & Sciences; the recipient of the Alexander von Humboldt Research Award for Senior U.S. Scientists, the IACM International Computational Mechanics Awards for Research, the USACM Computational Structural Mechanics Award and the ISI Highly Cited Researcher Award. He currently serves in different Laboratory and Review Panels such as the Lawrence Livermore National Laboratory among others and is in the editorial board of several international journals in the areas of theoretical mechanics, materials science and computational mechanics.

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