

SEMINARIOS INTERUNIVERSITARIOS MECÁNICA Y MATERIALES  
Lugar: Aula D, 1ª Planta, E.T.S.I. Industriales, Universidad Politécnica de Madrid,  
C/ José Gutiérrez Abascal, 2, Madrid, 28006.

**Speaker:** Professor Francisco Armero

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**Fecha y hora:** 25 de Marzo 2009 a las 13:00 h. (café desde 12:30).

**Finite Elements with Embedded Discontinuities and Branching for the  
Modeling of Failure in Solids**

The failure of solids and structures is often characterized by the appearance of discontinuous solutions of the mechanical boundary value problem, like the discontinuous displacements associated with cracks in brittle materials or with multi-scale treatments of shear bands and other localization bands in ductile failures. We present in this contribution several recent advances in the formulation of the so-called finite elements with embedded strong discontinuities. Exploiting the aforementioned multi-scale setting, these elements incorporate the kinematics of these highly non-smooth solutions through enhancements that are handled entirely at the element level, preserving the overall structure of the standard global mechanical/structural problem, and thus leading to efficient techniques for the numerical simulation of these failures in solids. Specifically we discuss the formulation of finite elements incorporating high-order interpolations of the displacement jumps along the discontinuity, in both the infinitesimal and finite deformation ranges. This strategy consists in the incorporation of the separation modes in the discrete strain field of the element, rather than the definition of a local discontinuous displacement field. After a discussion of these theoretical aspects, we present a series of representative numerical simulations illustrating the performance of the finite elements. We consider applications ranging from delamination in composites to ductile failures of elastoplastic solids in the quasi-static range, as well as dynamic fracture involving ductile/brittle mode transitions and crack branching in brittle materials.

*Brief CV of Francisco Armero*

Professor Francisco Armero, originally from Barcelona, Spain, is well known for his research in computational mechanics, with specific lines of research including computational failure mechanics and nonlinear dynamics. He is active in the mechanics community through technical societies, organizing conferences and being a member of scientific conference committees, as well as being a member of the editorial board of leading journals in the field. Honors and awards include: the ONR Young Investigator Award (1996), the NSF CAREER Award (1997), the Engineering Computations Best Paper Award (1997), the J.C. Simo Award and Medal by the Spanish Association of Numerical Methods in Engineering SEMNI (1999), the IACM Young Investigator Award by the International Association of Computational Mechanics (2002), and elected Fellow of this Association IACM in (2004).

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