POLITECNICO DI MILANO

MODELLISTICA E CALCOLO SCIENTIFICO
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SEMINAR

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Material instabilities: folding, faulting, and Cosserat solids

25 September 2015, 12:00 pm
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Abstract:
Materials with extreme mechanical anisotropy are designed to work near a material instability threshold where they display stress channelling and strain localization, effects that can be exploited in several technologies. Extreme couple stress solids are introduced and systematically analyzed in terms of several material instability criteria: positive-definiteness of the strain energy (implying uniqueness of the mixed b.v.p.), strong ellipticity (implying uniqueness of the b.v.p. with prescribed kinematics on the whole boundary), plane wave propagation, ellipticity, and the emergence of discontinuity surfaces.
The Green's functions for applied concentrated force and moment are obtained for Cosserat elastic solids with extreme anisotropy, which can be tailored to bring the material in a state close to an instability threshold such as failure of ellipticity. It is shown that the wave propagation condition (and not ellipticity) governs the behavior of the Green's functions. These Green's functions are used as perturbing agents to demonstrate in an extreme material the emergence of localized (single and cross) stress channelling and the emergence of localized folding (or creasing, or weak elastostatic shock) and faulting (or elastostatic shock) of a Cosserat continuum, phenomena which remain excluded for a Cauchy elastic material. During folding some components of the displacement gradient suffer a finite jump, whereas during faulting the displacement itself displays a finite discontinuity.

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