

Tuesday, April 7, 2009

4:00 pm

in Room 303 MAE-A

**"Finite strain micromorphic elastoplasticity:  
in the context of concurrent multiscale modeling  
of bound and unbound particulate materials"**

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In the micromorphic continuum theory of Eringen [1], it was proposed that microstructure of materials could be represented in a continuum framework using a micro-deformation tensor governing micro-element deformation, in addition to the deformation gradient governing macro-element deformation. The talk presents the formulation of finite strain micromorphic elastoplasticity [2] based on micromorphic continuum mechanics in the sense of Eringen. Multiplicative decomposition into elastic and plastic parts of the deformation gradient and micro-deformation are assumed [3, 4], and the Clausius-Duhem inequality is formulated in the intermediate configuration to analyze what stresses, elastic deformation measures, and plastic deformation rates are used/defined in the constitutive equations. The resulting forms of plastic and internal state variable evolution equations can be viewed as phenomenological at their various scales (i.e., micro-continuum and macro-continuum). The phenomenology of inelastic mechanical material response at the various scales can be different, but for demonstration purposes, J2 flow plasticity is assumed for each of three levels of plastic evolution equations identified, with different stress, internal state variables, and material parameters. All evolution equations and a semi-implicit time integration scheme are formulated in the intermediate configuration for future coupled Lagrangian finite element implementation. Extension to current configuration and inclusion of pressure-sensitive plasticity for geomaterials [5] may be discussed.

**References**

- [1] Eringen, A.C., *Microcontinuum Field Theories I: Foundations and Solids*, Springer-Verlag, 1999.
- [2] Regueiro, R.A., *On finite strain micromorphic elastoplasticity*, *International Journal of Solids and Structures*, 2008, in review.
- [3] Sansour, C., *Unified concept of elastic-viscoplastic Cosserat and micromorphic continua*, *Journal De Physique. IV*, 8(8):341-348, 1998.
- [4] Forest, S., Sievert, R., *Elastoviscoplastic constitutive frameworks for generalized continua*, *Acta Mechanica*, 160(1-2):71-111, 1998.
- [5] Regueiro, R.A., *A finite strain micromorphic pressure-sensitive plasticity model*, *ASCE Journal of Engineering Mechanics*, 2009, in press.

***Refreshments served in 303 MAE-A beginning at 3:50 pm***