Massachusetts Institute of Technology
Department of Mechanical Engineering

MMEC SEMINAR SERIES

Mechanics: Modelling, Experimentation, Computation

Tuesdays @ 4:00pm – Room 3-370 **March 04, 2014**

Laurence Brassart
University of Louvain

Homogenization of elasto-plastic composites – *An incremental variational approach*

Predicting the mechanical behavior of nonlinear heterogeneous materials requires careful modeling strategies. A classical continuum approach is often inappropriate, because it is specific to a given combination of microstructure and phase properties. It also requires the a priori knowledge of the general form of the constitutive behavior, which is often impossible on theoretical bases when the behavior of the constituents is nonlinear and/or dissipative. Alternatively, micromechanical approaches aim at predicting the overall (or "homogenized") response of the material starting from a description of the microstructure and the knowledge of the behavior of the constitutive phases. In particular, Mean-Field (MF) homogenization methods provide semi-analytical estimates of the effective response based on simplified relationships between the microfields statistics, typically the first and second order moments of stress and strain fields. The main advantage of MF methods is their low computational cost, allowing them to be used as constitutive models in large scale simulations of composite structures.

In this talk, I will present an original approach to determine the homogenized response of composite materials with elasto-(visco)plastic constituents. The formulation is based on an incremental variational principle according to which the local stress-strain relation derives from a single incremental potential constructed from a free energy and a dissipation function. The key feature of the model is the explicit use of the elastic trial strain in order to define a Linear Comparison Composite whose mechanical response can be estimated using available linear schemes. The hereditary character of the behavior is accounted for through internal variables which are found to obey a homogenized yield criterion and radial return condition, thus preserving the algorithmic structure of the incremental equations of elasto-plasticity in the homogenization procedure. The method correctly predicts the effective behavior in many cases, and several applications will be discussed.

Seminar Host: Ken Kamrin (kkamrin@mit.edu)

Please join us for ***refreshments beforehand, outside Room 3-370***

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Series Organizers: Ken Kamrin (kkamrin@mit.edu); Pedro Reis (preis@mit.edu); Kostya Turitsyn (turitsyn@mit.edu)

Coordinator: Tony Pulsone (x3-2294, pulsone@mit.edu)

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