Eulerian formulation of inelasticity – from metal plasticity to growth of biological tissues

MB Rubin
Faculty of Mechanical Engineering
Technion - Israel Institute of Technology
Haifa, Israel 32000
Email: mbrubin@tx.technion.ac.il

Abstract

An Eulerian formulation of constitutive equations for inelasticity is discussed which models metal plasticity and growth of biological tissues. Motivated by the early work of Eckart (1948) and Leonov (1976) evolution equations are proposed for elastic deformation measures directly. In contrast with Lagrangian formulations of constitutive equations, the Eulerian formulation is unaffected by arbitrariness of specified reference and intermediate configurations and definitions of total and inelastic strain measures. Eulerian evolution equations for a triad $\mathbf{m}_i$ of microstructural vectors model elastic deformation for fully anisotropic elastic-inelastic response. For growth of biological tissues, the evolution equations have been modified to model homeostasis, which is the inelastic process that causes a tendency for the elastic deformation measures to approach their homeostatic values. In particular, the stress in the homeostatic state can be non-zero. Robust, strongly objective numerical algorithms will also be discussed.