A Discrete Element Method for dynamic elastoplasticity recast as a Gradient Scheme

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Since their first use by Hoover et al (1974) in models for crystalline materials and Cundall & Strack (1979) in geotechnical problems, Discrete Elements Methods (DEM) have found a large field of application in granular materials, soil and rock mechanics. DEM consist in a system of masses and springs destined to simulate the dynamic behaviour of a continuous material.
In the Mka3D code, the authors [1] have been able to simulate the deformation and fragmentation of a three-dimensional linear elastic brittle material. The discretisation is achieved through Voronoi meshes. The forces and torques are computed directly through macroscopic quantities like the distance and relative rotation between two particles.
The aim of this presentation is twofold: recast DEM as a Gradient Scheme as defined in [2] and introduce an extension of its formalism with the goal to compute elasto-plasticity in metals. Elements of proof for the well-posedness and convergence of the discretisation shall be presented.
A special attention has been given to the correct approximation of the elastic inequality constraint. Since it is a nonlinear constraint, a new energy-momentum conserving time-integration scheme, developed in [3], has been used to ensure stability of the solid's dynamics computation over long times.

Références

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