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NON-SPECIALIST: Numerical Modelling of Pavement Materials

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Abstract content
   (Max 300 words)

In the field of transport infrastructure, the properties of the pavement of roads and rail tracks play critical roles. The aim of this project is to understand the performance of roads as a function of particle shape using laser characterisation and laboratory tests (Anochie-Boateng et al., 2012).
Statistical physics theories for simple shapes have been developed (Onsager, 1949), but numerical simulations provide a way to analyse the bulk properties of granular media for angular particle shapes. Rigid body dynamics are assumed. Discrete Element Models, DEM (Cundall and Strack, 1979), are becoming widely used, and a parallel investigation of dynamics in polyhedral particle DEM is under way (Munjiza, 2011). A more approximate, but much faster, method for hundreds of particles is to use physics engine software, which was developed for the fast-growing market for animation, robotics and virtual environments. The physics engine chosen for present purposes is PhysX™ (www.nvidia.com). The rigid body models are based on the constraint formulation of Hahn (1988) (Hahn, 1988) and further developed by Müller et al. (2008), and are based on stick-slip friction coefficients and coefficients of restitution which model inelastic collisions. An additional mechanism for kinetic energy damping is deactivation of particles having less than a defined threshold velocity.
Spherical or polyhedral particles are confined to a rigid frictionless cylinder with a fixed base, and a frictionless platen is lowered into contact with the top particles. Axial stress is imposed by adding masses to the platen, and the axial strain is measured.
Initial problems with imposed axial stress, and mitigation, are described. Stress-strain curves have been obtained. The failure mode of the numerical model under high stresses differs from the fracture of material particles. The effects of particle deactivation, friction coefficient, and particle shape (for regular solids) on the elastic modulus are shown and discussed.

Apply to be
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No

Level for award
 (Hons, MSc,
   PhD)?

None

Main supervisor (name and email)
and his / her institution

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Yes

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