

## **Chris Ness**

### Rheology of dense suspensions of granular rods in nature and industry

Dense suspensions of rod-shaped granular particles are widespread in nature and manufacturing, from lava and magma flows to recycled carbon fibre composites. In these scenarios, the fluid mechanical properties are often paramount for mitigation of natural hazards and design of engineering processes. The bulk mechanics often blur the solid-liquid boundary: the materials jam as more rods are added but yield and flow when rods are forced to rearrange. How do the rod-scale physics govern these capricious bulk mechanics? To address this, we have developed a particle-based simulation that models such suspensions under simple shear flow, providing predictions of the viscosity and microstructure for a given solids volume fraction and particle aspect ratio. The model tracks the trajectories of spherocylindrical rods under the action of short-range frictional contact and hydrodynamic forces. For aspect ratios up to 15, the model predicts a viscosity spike at shear start-up, giving way to steady state viscosities that increase systematically with volume fraction and aspect ratio. The particle arrangement evolves non-trivially, with alignment along the vorticity and flow directions at moderate and large volume fractions respectively, the crossover being sensitive to aspect ratio. Our model corroborates the limited experimental rheology data available for suspensions of granular rods, and offers a tool for fundamental exploration of the fluid mechanics, microstructure and rheology of this widespread material.