On the characteristics of slip instabilities in sheared granular layer

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ABSTRACT

The slip instabilities in sheared granular layer is thought to be representative of slip events in the central part of a fault, called fault gouge. To study effect of fluids on such instabilities, we conduct 3D discrete element method (DEM) coupled with computational fluid dynamics (CFD). Our CFD-DEM model is coarse-grained in space, having several spherical particles in a CFD cell. We allow the fluid to flow in/out form side boundaries. After confinement of sample vertically, we shear the sample horizontally to find the appropriate loading values, by which the system undergoes stick-slip cycles. In the stick phase, the granular system accumulates energy through elastic contacts between particles, whereas this stored energy is released during the slip event. Our numerical simulations show that the presence of fluid can facilitate slip process, producing bigger events in terms of shear stress drop and released kinetic energy. We highlight the importance of solid-fluid interaction forces for destabilisation of particles that are in contact, leading to enlarged slip events.