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Nature of stress accommodation in sheared fault gouge: Insights from 3D numerical modelling

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Active faults often contain distinct accumulations of granular wear material. During shear, this granular material accommodates stress and strain in a heterogeneous manner that may influence fault stability. We present new work to visualise the nature of stress distributions during 3D granular shear. Our 3D discrete numerical models consist of granular layers subjected to normal loading and direct shear, where gouge particles are simulated by individual spheres interacting at points of contact according to simple laws. During shear, we track the particle motion and contact interactions to determine the nature of internal stress accommodation with accumulated slip for different initial configurations. Our results highlight the prevalence of transient force chain networks that preferentially transmit enhanced stresses across our sheared granular layers. The morphology of the networks reflects specific grain characteristics and their style and distribution may directly influence macroscopic friction. Our numerical approach offers the potential to investigate correlations between force chain geometry, evolution and resulting macroscopic friction, thus allowing us to explore ideas that heterogeneous force distributions in gouge material may exert an important control on fault stability and hence the seismic potential of active faults.