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The effect of undulations on slip and opening of faults, a 3D study.

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Surface undulations can significantly change the resultant slip profile of a fault. Previous numerical modelling of this phenomena has been undertaken in 2D and studied the effects of geometrical irregularities introduced as a simple sinusoidal waveform. Although such a model is clearly an idealisation it supplies a first order insight into the mechanics of slip over non-planar surfaces. These 2D studies show how the total slip decreases due to corrugations geometry, lower slips as the amplitudes increase and the wavelengths decrease.
In this study, the displacement discontinuity boundary element method is employed to model the slip profiles of 3D fault surfaces in a linear elastic medium, the model explicitly accounts for frictional properties upon the fractures faces. We model reductions in slip due to corrugations relative to analytical formulas for planar faults in 2D and 3D allowing for dimensionless scalable results. We find slip reduction in 2D and 3D models is similar when asperities lie in orientations perpendicular to the slip direction and differ significantly as the asperities are rotated in alignment with the slip direction.
We go on to look at how slip over corrugations can cause separation of a faults faces in case of non-zero pore/internal pressure. The modelled shear fracture is subject to remote confining stresses driving slip on the fractures surface that are of far greater magnitude than the internal fluid pressures within the fractures. We find that much larger opening apertures can be obtained due to shearing of a corrugated fracture with internal pressure than those for a planar fracture with the same internal pressure that is unconfined by remote stresses.