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Two-scale evolution during shear reversal in dense suspensions
CHRISTOPHER NESS, JIN SUN, University of Edinburgh — We use shear reversal simulations to explore the rheology of dense, non-Brownian suspensions, resolving lubrication forces between neighbouring particles and modelling particle contacts as linear springs. The transient stress response to an abrupt reversal of the direction of shear shows rate-independent, nonmonotonic behaviour, capturing the salient features of the corresponding classical experiments. Based on analyses of the hydrodynamic and particle contact stresses and related contact networks, we demonstrate distinct responses at small and large strains, associated with contact breakage and structural re-orientation, respectively, emphasising the importance of particle contacts. Consequently, the hydrodynamic and contact stresses evolve over disparate strain scales and with opposite trends, resulting in nonmonotonic behaviour when combined. We further elucidate the roles of particle roughness and repulsion in determining the microstructure and hence the stress response at each scale.

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