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Shear flow of angular grains: Acoustic effects and stick-slip instabilities CHARLES K. C. LIEOU, University of California, Santa Barbara, AHMED E. ELBANNA, University of Illinois at Urbana-Champaign, JAMES S. LANGER, JEAN M. CARLSON, University of California, Santa Barbara — We propose a model for stick-slip instabilities in a sheared granular medium composed of frictional grains. We show that friction between particles is essential in producing stick-slip failure at inter-mediate shear rates, even if the material is rate-strengthening in character in the limit of large shear rates. In addition, externally generated acoustic vibrations promote stick-slip instabilities at low shear rates, but suppresses it at low confining pressure. We construct separate phase diagrams that indicate the parameter regimes for which stick-slip occurs, in the presence and absence of acoustic vibrations. These results connect the microscopic physics to macroscopic stress dynamics, elucidate the role of interparticle frictional interactions and acoustic vibrations on frictional dynamics, and provide important insight on the physical origin of earthquake rupture and seismic slip. Our findings show good agreement with laboratory experiments on simulated fault gouge.

Charles K. C. Lieou
University of California, Santa Barbara

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