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Role of Compressibility for Granular Flow KEVIN LU, HOSSEIN KAVEHPOUR, Mech. and Aero. Eng., UCLA, EMILY BRODSKY, Dept. of Earth Sciences, UCSC — We study the transitional flow of a simple-sheared dry granular assembly. Between the familiar limiting regimes (grain-inertial and quasi-static) of granular flow, the physical description of the intermediate regime remains elusive. Our experiment utilizes a top-rotating torsional shear cell capable of micron gap accuracy and a velocity range. The results show that the shear and normal stresses exhibit an inverse rate-dependence under a controlled-gap environment in the transitional regime, while capturing the limiting regimes in agreement with previous work. The empirical data illustrates a previously unknown 'dip' in the stress response to increasing shear rate. Under a controlled-force environment, however, the packing fraction is observed to be a positive function of strain rate within intermediate shear rates. We infer from our results that fluidized granular compressibility, as a function of rate, is a significant factor in granular dynamics. To account for the observations, a theoretical model is derived in an attempt to unify our findings. The formulation provides an equation of state for dynamic granular systems, with state variables of pressure, strain rate, and packing fraction.

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