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The Stochastic Flow Rule and Rate Sensitivity in Dense Granular Flows. KEN KAMRIN, CHRIS H. RYCROFT, MARTIN Z. BAZANT, MIT — The Stochastic Flow Rule (SFR) is a constitutive law which, when used with limit-state Mohr-Coulomb plasticity for stresses, gives predictions for the mean velocity field in quasi-2D dense granular flows. It is based on a simple microscopic flow mechanism, where "spots" of free volume perform random walks along slip-lines, biased by stress imbalances upon local fluidization. The SFR has recently been shown to predict dense granular flows in diverse geometries— e.g. draining silos, annular Couette cells, and plate-dragging experiments— without the use of fitting parameters. However, a significant rheological change occurs in certain geometries— e.g. inclined plane flow and gravity-free horizontal shear flow— where the packing fraction is nearly uniform and a distinct stress/strain-rate relationship arises. In this talk, we review the SFR and propose a simple explanation of when and why rate sensitivity occurs, depending on the slip-line geometry. We also postulate how rate-dependent terms may be combined with the SFR to create a more universal theory of dense flows.

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