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Capturing nonlocal effects in 2D granular flows KEN KAMRIN, MIT, GEORG KOVAL, INSA Strasbourgh — There is an industrial need, and a scientific desire, to produce a continuum model that can predict the flow of dense granular matter in an arbitrary geometry. A viscoplastic continuum approach, developed over recent years, has shown some ability to approximate steady flow and stress profiles in multiple inhomogeneous flow environments. However, the model incorrectly represents phenomena observed in the slow, creeping flow regime. As normalized flow-rate decreases, granular stresses are observed to become largely rate-independent and a dominating length-scale emerges in the mechanics. This talk attempts to account for these effects, in the simplified case of 2D, using the notion of nonlocal fluidity, which has proven successful in treating nonlocal effects in emulsions. The idea is to augment the local granular fluidity law with a diffusive second-order term scaled by the particle size, which spreads flowing zones accordingly. Below the yield stress, the local contribution vanishes and the fluidity becomes rate-independent, as we require. We implement the modified law in multiple geometries and validate its flow and stress predictions in multiple geometries compared against discrete particle simulations. In so doing, we demonstrate that the nonlocal relation proposed is satisfied universally in a seemingly geometry-independent fashion.

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