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Interplay between hysteresis and nonlocality in granular flows SAVIZ MOWLAVI, KEN KAMRIN, MIT — The jamming transition in granular materials is well-known to exhibit hysteresis, wherein the level of shear stress required to trigger flow is larger than that below which flow stops. From a rheological standpoint, such behavior is typically modeled as a nonmonotonic flow rule. However, the rheology of granular materials is also nonlocal due to cooperativity at the grain scale, leading to increased strengthening of the flow threshold as system size is reduced. We investigate how these two effects – hysteresis and nonlocality – couple with each other by incorporating nonmonotonicity of the flow rule into the nonlocal granular fluidity (NGF) model, a nonlocal continuum model for granular flows. Comparing predictions of the model with discrete element simulations in the case of planar shear flow with gravity, we show that the inclusion of nonlocal effects is key to explaining certain features of the hysteretic solid-liquid transition as the applied stress is ramped up and down.

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