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A Coupled CFD-DEM Simulation of Immersed Granular Collapse

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Natural disasters normally involve the flow of polydispersed granular materials with interstitial fluid which may change the flow dramatically. Here we focus on a typical small-scale case of fluid–particle mixture flows, i.e., the immersed granular collapse using computational fluid dynamics coupled with discrete element method (CFD-DEM). The simulation parameters are calibrated with laboratory experiments and the immersed granular collapse process is reproduced in terms of different aspect ratios. We present a deeper investigation of the collapse based on simulation results. The granular front evolves in three stages, i.e., acceleration, steady propagation, and deceleration. We found that the constant propagation stage is maintained by the transition of particles' motion from vertical to horizontal and the drag of the fluid. The constant propagation velocity is proportional to the free-fall velocity with a Stokes-number-dependent coefficient and the normalized final runout is linearly correlated with the densimetric Froude number. These conclusions may find its significance in geophysical applications.