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The Role of Vorticity and Turbulence on the Instability of a Dense Solid Particle Flow FUE-SANG LIEN, TAO XU, University of Waterloo, FAN ZHANG, DRDC-Suffield, Canada — The dense solid particle flow regime lies between the dilute particle flow and packed granular bed limit and its flow topology is characterized by a large number of particle interactions. Such a flow regime is frequently observed in the initial expansion of detonation products from a heterogeneous explosive containing solid particles. Due to the stochastic nature of the interactions, instability of particle trajectories occurs including clustering, agglomeration and collision, which may lead to a nonuniform spatial distribution or macroscopic particle jet structures. Large eddy simulations at mesoscale are used to gain insight into the physical mechanisms for this instability of particle dynamics, in which the Immersed Boundary Method is applied to simulate a group of randomly distributed moving particles in a post-detonation flow. A criterion is established to represent the tendency of particle agglomeration, either based on divergence of particle velocity related to the difference between strain-rate and vorticity invariants or time derivative of particle volume fraction. The criterion is further evaluated based on our mesoscale solutions in order to show the role and importance of each physical mechanism involved. Preliminary mesoscale results for dispersal of densely-packed particles in a cylindrical charge and its possible connection to the formation of macroscopic particle jet structure will be discussed.

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