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Investigation of unsteadiness in Shock-particle cloud interaction: Fully resolved two-dimensional simulation and one-dimensional modeling

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— Dense compressible particle-laden flow, which has a complex nature, exists in various engineering applications. Shock waves impacting a particle cloud is a canonical problem to investigate this type of flow. It has been demonstrated that large flow unsteadiness is generated inside the particle cloud from the flow induced by the shock passage. It is desirable to develop models for the Reynolds stress to capture the energy contained in vortical structures so that volume-averaged models with point particles can be simulated accurately. However, the previous work used Euler equations, which makes the prediction of vorticity generation and propagation innacurate. In this work, a fully resolved two dimensional (2D) simulation using the compressible Navier-Stokes equations with a volume penalization method to model the particles has been performed with the parallel adaptive wavelet-collocation method. The results still show large unsteadiness inside and downstream of the particle cloud. A 1D model is created for the unclosed terms based upon these 2D results. The 1D model uses a two-phase simple low dissipation AUSM scheme (TSLAU) developed by [Hosseinzadeh-Nik *et.al*, 53rd AIAA Aerospace Sciences Meeting (2015)] coupled with the compressible two phase kinetic energy equation.

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