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Two-phase flow modeling for gas-solid granular mixtures with dense-to-dilute concentration

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We consider modeling of gas-solid granular medium flow in wide range of solid volume fractions. In such flows concentration of the solid phase changes from dilute (low concentration) to dense (high concentration). For gas-solid granular mediums many macroscopic models are well-known. The 6-waves 7-equations Baer-Nunziato model (BN) [1] has been designed for gas-solid granular mixtures with dense concentration of the solid phase. For gas-solid granular mixtures with dilute concentrations of the solid phase the one-pressure model of [2] can be used. However, the one-pressure model is not hyperbolic in the whole range of model parameters. The question is how to switch in simulation from one existed model to another is open, as the models has different number of equations and use different closure relations. We propose the hyperbolic thermodynamically consistent model which covers all concentrations of the solid phase in unique approach. The switch from dense to dilute concentration flow is realized with the predescribed criterion of the phase connectivity. We compare the proposed model with existed models on several test problems including shock wave interaction with a dusty layer. All simulations are realized on moving Euler grid using Godunov solver with approximation of non-conservative numerical flux by HLLEM method [3].

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