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Numerical simulations of shock wave propagation in granular materials with the multi-phase particle-in-cell method[1] KUN XUE, Beijing Institute of Technology — In this work, we numerically investigate the compression of granular phase and the gas infiltration during the shock propagation inside particle columns using the multi-phase particle-in-cell (MP-PIC) method. The gaseous phase is modeled by a high-order accurate five-equations compressible multiphase approach while the motions of discrete particles are governed by Newton's second law which incorporates the transfer of momentum and energy between particle and gaseous phases such that the coupling of particles and gases are fully taken into account. The simulation experiments of the head-on impacts between weak shock waves and particle columns with different permeability reveals how the pore pressure and the total pressure dissipate with the propagation depth. The former strongly depends on the permeability of particle phases while stresses formed inside the granular skeletons which are the total pressure subtracted by the pore pressure are correlated with the solid compression. Also the gas infiltration plays a crucial role in the formation of stresses. Complex, three-dimensional load transfer processes in the granular media, which are extremely difficult to understand from experiments, are visualized based on the results from the present MP-PIC simulation.

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