Abstract Submitted
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Material Point Methods for Shock Waves[1] DUAN ZHANG, TILAK DHAKAL, Los Alamos National Laboratory — Particle methods are often the choice for problems involving large material deformation with history dependent material models. Often large deformation of a material is caused by shock loading, therefore accurate calculation of shock waves is important for particle methods. In this work, we study four major versions (original MPM, GIMP, CPDI, and DDMP) of material point methods, using a weak one-dimensional isothermal shock of ideal gas as an example. The original MPM fails. With a small number of particles, the GIMP and the CPDI methods produce reasonable results. However, as the number of particles increases these methods do not converge and produce pressure spikes. With sparse particles, DDMP results are unsatisfactory. As the number of particles increases, DDMP results converge to correct solutions, but the large number of particles needed for an accurate result makes the method very expensive to use in shock wave problems. To improve the numerical accuracy while preserving the convergence, conservation, and smoothness of the DDMP method, a new numerical integration scheme is introduced. The improved DDMP method is only slightly more expensive than the original DDMP method, but accuracy improvements are significant as shown by numerical examples.

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