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# Acoupled finite difference material point method for high explosive explosion problems

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Simulations of high explosive (HE) explosion are characterized by a number of challenging behaviours including highly pressurized product gas propagating into the quiescent surrounding air and the following fluid structure interaction (FSI) with the structures nearby. Taking advantages of thefinite difference method (FDM) andmaterial point method (MPM), a coupled finite difference material point (CFDMP) method is proposed for modelling the 3D HE explosion and its interaction with the surrounding structures.The problem domain is divided into two computational regions in space.FDM is employed to simulate the region where the detonation products disperse into the surrounding air, whilethe region where FSIoccurs is simulated by MPM.Between the two computational regions, a “bridge region” is employed to carry out the information exchange between them. In the bridge region, MPM provides the boundary condition for FDM region by projecting the value from particles to the boundary points of FDM, while FDM provides the boundary condition for MPM region by projecting value from cell-centre points to boundary grid nodes of MPM. The transport between the two computational regions is implemented by movingparticles in the bridge region.Referring to the work by York, a contact algorithm is also implemented to relax the automatic no-slip contact algorithm in MPM when components separate. It is used to handle the FSI process between the high-speed gas and the structures to avoid unphysical penetration.In several numerical tests, predictions of the proposed method are in good agreement with theoretical solutions or empirical formulae. They illustrate that the method can yield good prediction for the entire HE explosion process.

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