APCOM & ISCM
11-14th December, 2013, Singapore

Some developments of SPH in modeling explosion and impact problems

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Explosion and impact problems are generally characterized by the presence of shock waves, intense localized materials response and intensive loadings. Most of the wave propagation hydro-codes for such problems use traditional grid based methods such as finite difference methods (FDM) and finite element methods (FEM). Though many successful achievements have been made using these methods, some numerical difficulties still exist. These numerical difficulties generally arise from large deformations, large inhomogeneities, and moving interfaces, free or movable boundaries. Smoothed particle hydrodynamics (SPH) is a Lagrangian, meshfree particle method, and has been widely applied to different areas in engineering and science. SPH method has been intensively used for simulating high strain hydrodynamics with material strength, due to its special features of meshfree, Lagrangian and particle nature. In this paper, some recent applications of the SPH in modeling explosion and impact problems will be introduced. A modified scheme for approximating kernel gradient (kernel gradient correction, or KGC) has been used in the SPH simulation to achieve better accuracy and stability. The modified SPH method is used to simulate a number of problems including 1D TNT detonation, 2 and 3D contact explosion, 3D impact and penetration, 2D linear shaped charge, and explosively driven welding. The effectiveness of the modified SPH method has been demonstrated by comparative studies of the SPH results with data from other resources.

Keywords: Smoothed particle hydrodynamics (SPH), explosion, impact, shaped charge, explosively driven welding