

Development of multiscale particle discretization within the MPM framework

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Abstract

Recent investigations of energetic composites have underscored the need for an effective multiscale procedure for simulating the size-dependent responses of discrete nano/meso/micro structures to extreme loading [Chen *et al.*, 2012b and 2014b; Jiang *et al.*, 2012; among others]. A particle-based computer test-bed is being developed to simulate and evaluate different types of energetic composite designs, with a concurrent link between the Dissipative Particle Dynamics (DPD) method and the Material Point Method (MPM), and a hierarchical bridge from Molecular Dynamics (MD) to DPD [Chen *et al.*, 2012a and 2014a]. In order to effectively discretize the multiphase interactions associated with multiscale failure evolution, the recent research is focused on the development of multiscale particle discretization in space within the MPM framework. The proposed discretization procedure has been illustrated using simulations of the dynamic and impact responses of discrete metallic nano/meso/micro structures. It appears that the DPD forces can be effectively coarse-grained using the MPM background grid, and that the concurrent link between the MPM and DPD enables near-seamless integration of constitutive modeling at the continuum level with force-based modeling at the mesoparticle level. Representative examples will be considered to demonstrate the recent research results in concurrent simulation of MD, DPD and MPM in a single computational domain.

Keywords: Multiscale, Particle Methods, Material Point Method, Size Effect, Impact Response

References

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