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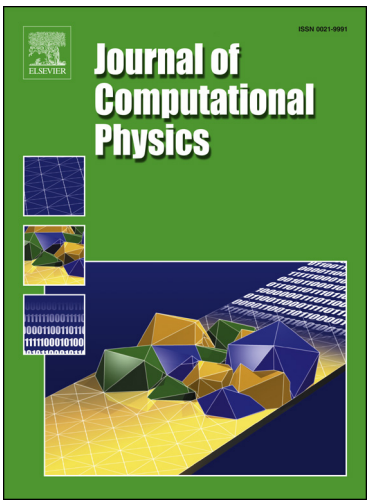

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An Extension of Godunov SPH II: Application to Elastic Dynamics

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Abstract

Godunov Smoothed Particle Hydrodynamics (Godunov SPH) method is a computational fluid dynamics method that utilizes a Riemann solver and achieves the second-order accuracy in space. In this paper, we extend the Godunov SPH method to elastic dynamics by incorporating deviatoric stress tensor that represents the stress for shear deformation or anisotropic compression. Analogously to the formulation of the original Godunov SPH method, we formulate the equation of motion, the equation of energy, and the time evolution equation of deviatoric stress tensor so that the resulting discretized system achieves the second-order accuracy in space. The standard SPH method tends to suffer from the tensile instability that results in unphysical clustering of particles especially in tension-dominated region. We find that the tensile instability can be suppressed by selecting appropriate interpolation for density distribution in the equation of motion for the Godunov SPH method even in the case of elastic dynamics. Several test calculations for elastic dynamics are performed, and the accuracy and versatility of the present method are shown.

Keywords: Smoothed Particle Hydrodynamics, Elastic dynamics, Tensile instability, Linear stability analysis, Godunov's method

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