Particle-In-Cell Method using Hierarchical Cartesian Mesh for Deformable Solid-Fluid Interaction Problems

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ABSTRACT

The authors have developed a full Eulerian scheme for nonlinear solid dynamics [1] and a full Eulerian deformable solid-fluid interaction scheme using a fixed hierarchical Cartesian mesh suitable for large-scale parallel computing [2]. A full Eulerian method, however, cannot avoid the numerical dissipation of material interfaces and history-dependent variables of solid due to the advection. Even if a high-order advection scheme is adopted, material interfaces and history-dependent variable become diffusive gradually with time. Due to this problem, full Eulerian methods cannot accurately compute geometrically complex structure or solid with many history-dependent variables.

Given the aforementioned background, in this work, we propose a particle-in-cell method using a fixed hierarchical Cartesian mesh for fluid-structure interaction problems. To avoid numerical dissipation of material interfaces and history-dependent variables of solid, Lagrangian particles represent the solid region and carry history-dependent variables such as solid deformation tensor. A hierarchical Cartesian mesh is used to effectively represent complex solid geometries. The unified equation of motion for fluid and structure [2] and spatial derivatives such as velocity gradient tensor are computed on the fixed Cartesian mesh. To verify the present approach, several numerical examples will be demonstrated in the presentation.

REFERENCES
