A multi-resolution SPH model for modeling fluid-elastic structure interactions

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ABSTRACT

In this paper, we present a multi-resolution SPH [1, 2] model for efficient and accurate modeling of fluid-elastic structure interactions (FSI) with applications to biology. The basic idea is to couple the fluid model, which is founded on solving the mass continuity and Navier-Stokes equations by using update Lagrangian formulation,and the structure model, which is based on implementing the total Lagrangian formulation to discretize the elastic dynamics, within multi-resolution framework [3]. The present multi-resolution coupling is conducted in a multi-resolution scenario where the computational domain is pre-partitioned into a fluid/structure subdomains which are discretized with predefined particle spacing. To ensure the consistency of particle-based discretizations, and mass and momentum conservation in fluid-structure interface, a new position-based Verlet scheme is proposed for physics relaxation process. Furthermore, the time average structure velocities are introduced for accurate and robust fluid-structure interface treatment. A set of benchmark tests is studied to validate the convergence, accuracy and robustness of the present multi-resolution SPH model without sacrificing accuracy. Furthermore, the versatility of the present model is demonstrated through modeling applications in biological system and good performance is obtained for implying promising potential employability of the present model.

REFERENCES

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