ICCES, 2024, vol.31, no.3
DOI: 10.32604/icces.2024.011902

PROCEEDINGS

Boundary Data Immersion Method for the Simulation of Fluid-Structure Interaciton Based on DGM

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ABSTRACT

Immersed boundary method (IBM) has been widely applied in the simulation of fluid-structure interaction problems. The traditional direct force model is less accurate, and the sharp-interface approaches involve complex topological operations which are not conducive to dealing with complex structures. The boundary data immersion method (BDIM) is a new fluid-structure coupling scheme that does not need to cut the mesh and can be extended to reach second-order accuracy. However, the traditional boundary data immersion method needs special treatment to deal with the sharp corners of the structure. In the present work, the volume fraction of fluid and structure is obtained by the smooth kernel approximation, which greatly enhances the applicability of the BDIM algorithm in the fluid-structure coupling of complex structures. By using BDIM, the DGM fluid solver and the RKPM structure solver are coupled to achieve accurate prediction of ship structure damage subjected to the underwater explosion, which lay the foundation for the optimization design of ship defensive structure.

KEYWORDS

Boundary data immersion method; discontinuous Galerkin method; fluid-structure interaction; smooth kernel approximation

Funding Statement: The authors received no specific funding for this study.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.