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A sharp, robust, conservative cut-cell immersed boundary technique PETER BRADY, OLIVIER DESJARDINS, Cornell University — Simulation of solid-fluid systems with complex boundaries can be greatly simplified using immersed boundary (IB) methods. IB methods have have been used for many years because they provide an alternative to using a full body-fitted mesh, which often requires an unstructured CFD code. However, using a non body-fitted mesh with IB creates new challenges, including insufficient accuracy in the application of boundary conditions and the potential lack of conservation properties. Yet, discrete conservation can be obtained by using a cut-cell IB approach, where the cells that intersect with the solid body are cut such that they become body-fitted. Challenges typically associated with cut-cell methods include: expensive geometry manipulations (especially in three dimensions), the creation of arbitrarily small cut-cells and a modified discretization in those cut-cells. We address these issues by representing the interface implicitly and computing the cut-cell geometry using a marching tetrahedra algorithm. The discretization is then modified in the cut-cells using this geometric information. The code is verified and several techniques for handling small cells and the application of boundary conditions at the IB surface are evaluated using the method of manufactured solutions.

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