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A sharp, robust, and conservative geometric immersed boundary technique for moving boundaries PETER BRADY, OLIVIER DESJARDINS, PERRINE PEPIOT, Cornell University — Simulation of solid-fluid systems with complex moving boundaries can be greatly simplified using immersed boundary (IB) methods. IB methods allow for the representation of complex geometries on simple (i.e., Cartesian) meshes, providing an alternative to using a full body-fitted mesh, which often requires an unstructured CFD code and a costly grid-regeneration procedure at every time step. 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. These challenges are further exacerbated when considering a moving IB. Using a cut-cell IB approach, where the cells that intersect with the solid body are cut such that they become body-fitted, allows for a sharp, discretely conservative IB treatment. With moving geometries, sharp IB methods tend to lack robustness due to the "fresh-cell/dead-cell" problem - the addition or removal of fluid control volumes from the mesh. Rather than relying on an interpolation/smoothing operation to address this issue, a novel semi-Lagrangian geometric transport scheme is used. This fully conservative treatment is verified using the method of manufactured solutions and validated with several complex flows.

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