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Immersed boundary method implemented in lattice Boltzmann GPU code BRIAN DEVINCENTIS, KEVIN SMITH, JOHN THOMAS, Johns Hopkins University Applied Physics Laboratory — Lattice Boltzmann is well suited to efficiently utilize the rapidly increasing compute power of GPUs to simulate viscous incompressible flows. Fluid-structure interaction with solids of arbitrarily complex geometry can be modeled in this framework with the immersed boundary method (IBM). In IBM a solid is modeled by its surface which applies a force at the neighboring lattice points. The majority of published IBMs require solving a linear system in order to satisfy the no-slip condition. However, the method presented by Wang et. al. (2014) is unique in that it produces equally accurate results without solving a linear system. Furthermore, the algorithm can be applied in a parallel manner over the immersed boundary and is, therefore, well suited for GPUs. Here, a 2D and 3D version of their algorithm is implemented in Sailfish CFD, a GPU-based open source lattice Boltzmann code. One issue unaddressed by most published work is how to correct force and torque calculated from IBM for translating and rotating solids. These corrections are necessary because the fluid inside the solid affects its inertia in a non-trivial manner. Therefore, this implementation uses the Lagrangian points approximation correction shown by Suzuki and Inamuro (2011) to be accurate.

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