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cuIBM: a GPU-based immersed boundary method code

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Summary

cuIBM solves the two-dimensional Navier-Stokes equations with an immersed-boundary method on structured Cartesian grids. With this solution approach, we remove the constraint for the computational grid to fit to the surface of a body immersed in a fluid. This has the advantage of requiring simple and easy-to-generate fixed Cartesian grids. cuIBM can be used to simulate the flow around fixed or moving bodies without the need to re-generate grids. Example applications may include flapping airfoils for the study of animal flight or fish locomotion. The equations are spatially discretized with a finite-difference technique and temporally integrated via a projection approach seen as an approximate block-LU decomposition (Perot (1993)). cuIBM implements various immersed-boundary techniques that fit into the framework of Perot's projection method. Among them are the immersed-boundary projection approach from Taira and Colonius (2007), the direct-forcing method from Fadlun et al. (2000), and a second-order accurate direct-forcing method (Krishnan (2015)).

cuIBM is written in C++ and exploits NVIDIA GPU hardware using CUDA and CUSP, an open-source C++ library for sparse linear algebra on CUDA-capable GPUs. cuIBM solves the linear systems of equations and applies stencil operations on a single GPU device.

cuIBM generated the results published in Krishnan et al. (2014), a study of gliding-snake aerodynamics using an anatomically accurate cross-section of the snake *Chrysopelea Paradisi*.

References

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