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**An Immersed Boundary Method for the Incompressible Navier-Stokes Equations Based on the Lattice Green's Function Method**[1] SEBASTIAN LISKA, TIM COLONIUS, California Institute of Technology — A parallel, three-dimensional immersed boundary method is developed to solve external, viscous incompressible flows on an infinite domain. The equations are formally discretized on an infinite staggered Cartesian grid. An advantage of the infinite grid is automatic commutativity of operators and associated conservation properties. The Lattice Green's Function (LGF) method is used to reduce the solution to a finite portion of the grid. The LGF method uses the fundamental solutions of discrete operators on infinite grids analogously to solving continuous inhomogeneous differential equations using Green's functions. The differential-algebraic-equations that describe the temporal evolution of the discrete momentum equation, the incompressibility constraint, and the no-slip constraint are numerically solved by combining an integrating factor technique for the viscous term and a half-explicit Runge-Kutta scheme for the convective term. A nested projection technique is used to efficiently solve the algebraic system of equations involved in each stage of the time march. Fast solutions to the discrete elliptic problems that arise from the projection technique are obtained through a new solver based on the LGF that shares constructs from fast multipole methods and tree-algorithms. Results for three-dimensional test problems are presented, and the performance and scaling of the present implementation are discussed.

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Sebastian Liska
California Institute of Technology

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