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A mesh refinement framework for the lattice Green's function method for incompressible flows[1] KE YU, Caltech, BENEDIKT DORSCHNER, ETH Zurich, TIM COLONIUS, Caltech — We develop an adaptive mesh refinement strategy compatible with the lattice Greens function (LGF) technique for solving viscous, incompressible flows on unbounded domains. The LGF method exploits the regularity of a finite-volume scheme on a formally unbounded Cartesian mesh to yield robust (conservative, stable) and computationally efficient (linear complexity) solutions. The original method is spatially adaptive, but embedded mesh refinement is challenging to integrate with the underlying LGF which is only defined for a fixed resolution. We present a strategy for mesh refinement where the solution to the pressure Poisson equation is approximated using the LGF technique on a composite mesh constructed from a series of infinite lattices of differing resolution. For the incompressible Navier-Stokes equations, this is further combined with an integrating factor for the viscous terms and an appropriate Runge Kutta scheme for the resulting differential-algebraic equations. The parallelized algorithm is validated with numerical simulations of vortex rings. The collision of vortex rings at high Reynolds number is simulated to highlight the reduction in computational cells achievable with both spatial and the refinement adaptivity.

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