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A fully conservative finite-volume method for incompressible Navier-Stokes equations on locally refined nested Cartesian grids[1]
ADAMANDIOS SIFOUNAKIS, DONGHYUN YOU, SATBIR SINGH, Carnegie Mellon University — A second-order-accurate finite-volume method is developed for the solution of incompressible Navier-Stokes equations on locally refined nested Cartesian grids. Numerical accuracy and stability on locally refined nested Cartesian grids are achieved using a finite-volume discretization of the incompressible Navier-Stokes equations based on higher- order conservation principles - *i.e.*, in addition to mass and momentum conservation, kinetic energy conservation in the inviscid limit is used to guide the selection of the discrete operators and solution algorithm. Hanging nodes at the interface are *implicitly* slanted to improve the pressure-velocity projection, while the other parts of the grid maintain an orthogonal Cartesian grid topology. The present method is found to significantly improve the computational efficiency while it is straightforward to implement. The present method shows superior conservation of mass, momentum, and kinetic energy compared to the conventional methods employing interpolation at the interface between coarse and fine grids in simulations of Taylor vortex, lid-driven cavity flow, and flow over a square cylinder.

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