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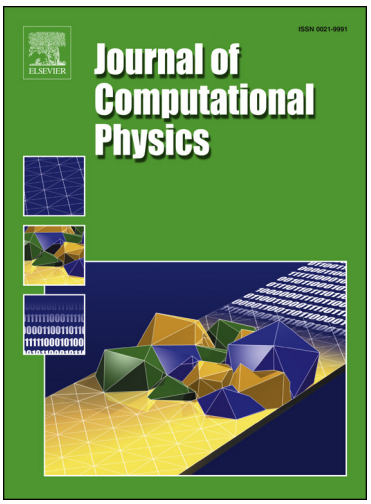

Preconditioned characteristic boundary conditions based on artificial compressibility method for solution of incompressible flows

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Preconditioned characteristic boundary conditions based on artificial compressibility method for solution of incompressible flows

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Abstract

The preconditioned characteristic boundary conditions based on the artificial compressibility (AC) method are implemented at artificial boundaries for the solution of two- and three-dimensional incompressible viscous flows in the generalized curvilinear coordinates. The compatibility equations and the corresponding characteristic variables (or the Riemann invariants) are mathematically derived and then applied as suitable boundary conditions in a high-order accurate incompressible flow solver. The spatial discretization of the resulting system of equations is carried out by the fourth-order compact finite-difference (FD) scheme. In the preconditioning applied here, the value of AC parameter in the flow field and also at the far-field boundary is automatically calculated based on the local flow conditions to enhance the robustness and performance of the solution algorithm. The code is fully parallelized using the Concurrency Runtime standard and Parallel Patterns Library (PPL) and its performance on a multi-core CPU is analyzed. The incompressible viscous flows around a 2-D circular cylinder, a 2-D NACA0012 airfoil and also a 3-D wavy cylinder are simulated and the accuracy and performance of the