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Spectral element methods for large scale parallel Navier-Stokes calculations. (English)

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Comput. Methods Appl. Mech. Eng. 116, 69-76 (1994).

Summary: We analyze the computational complexity of a recently developed two-level iteration scheme for spectral element solution of the time-dependent incompressible Navier-Stokes equations in complex domains. We present several algorithmic advances which significantly enhance the scalability of this approach, including: implementation of an advanced combine operation for degrees-of-freedom on subdomain edges, parallel solution of the (fine-grained) coarse-grid problem, and implementation of local low- order finite element preconditioners for the find-grid problem. Timings on the 512 node Intel Delta machine show that the combined improvements lead to a fourfold reduction in Navier-Stokes solution time for the particular case of a three-dimensional boundary layer calculation consisting of one million degrees-of-freedom.

MSC:

76M25	Other numerical methods (fluid mechanics) (MSC2010)
76D05	Navier-Stokes equations for incompressible viscous fluids
65M70	Spectral, collocation and related methods for initial value and initial-boundary value problems involving PDEs
65Y05	Parallel numerical computation

Keywords:

two-level iteration scheme; complex domains; coarse-grid problem; local low-order finite element preconditioners; find-grid problem; Intel Delta machine; boundary layer

Full Text: DOI

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