# On direct inverse of Stokes, Helmholtz and Laplacian operators in view of time-stepper-based Newton and Arnoldi solvers in incompressible CFD

H. Vitoshkin, A .Gelfgat

*(Submitted on 13 Jul 2011)*

Factorization of the incompressible Stokes operator linking pressure and velocity is revisited. The main purpose is to use the inverse of the Stokes operator with a large time step as a preconditioner for Newton and Arnoldi iterations applied to computation of steady three-dimensional flows and to study of their stability. It is shown that the Stokes operator can be inversed within an acceptable computational effort. This inverse includes fast direct inverses of several Helmholtz operators and iterative inverse of the pressure matrix. It is shown, additionally, that fast direct solvers can be attractive for the inverse of the Helmholtz and Laplace operators on fine grids and at large Reynolds numbers, as well as for other problems where convergence of iterative methods slows down. Implementation of the Stokes operator inverse to time-stepping-based formulation of the Newton and Arnoldi iterations is discussed.

Subjects: **Computational Physics (physics.comp-ph)**
Cite as: **arXiv:1107.2461 [physics.comp-ph]**
(or **arXiv:1107.2461v1 [physics.comp-ph]** for this version)

## Submission history

From: Alexander Gelfgat [view email]
**[v1]** Wed, 13 Jul 2011 04:10:37 GMT (1438kb)

*Which authors of this paper are endorsers?*