Implementation of a second order projection method for viscous incompressible flow

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Summary

In the final project, we plan to solve the two dimensional Navier-Stokes equations based on [1]. The method is a second-order fractional step scheme, where diffusion-convection equations are firstly solved to determine intermediate velocities, which are then projected onto the space of divergence-free vector fields. The discretization of the projection operator introduced in the original paper will be replaced with an approximate projection derived by Lai [2]. Lai's projection method is a modification that accounts for the non-zero divergence of the velocity and has a second order accuracy both in space and time. Finally, convergence and performance of our numerical implementation will be verified by applying the method to vortex spindown in a box, similarly to the test case introduced in the original paper.

References

[1] J. Bell, L. Howell, and P. Colella, An efficient second-order projection method for viscous incompressible flow, in *10th Computational Fluid Dynamics Conference*, p. 24, Reston, Virginia, 1991, American Institute of Aeronautics and Astronautics.

[2] M. F. Lai, *A Projection Method for Reacting Flow in the Zero Mach Number Limit*, Ph.d. thesis, University of California at Berkeley, 1993.