

In this thesis, the different solution methods for saddle-point systems arising from fluid dynamics are studied. The main emphasis is on Krylov subspace methods with effective preconditioning techniques for saddle-point systems obtained from finite element discretization of the Navier-Stokes equations. Two preconditioning techniques are presented: pressure-convection-diffusion preconditioning (PCD) and least-square commutator preconditioning (LSC). Both preconditioners are validated on two benchmarks: lid-driven cavity and flow around cylinder. From the computational point of view, we focus on comparing the performance of used solvers, with emphasis on our implementation of PCD preconditioning. All numerical simulations are performed by software Firedrake.