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Augmented Lagrangian preconditioner for fluids on surfaces

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Augmented Lagrangian preconditioner for linearized incompressible Navier-Stokes equations has been introduced in [1,2]. Over the years it was proved to be an efficient technique to solve highly non-symmetric algebraic systems having a saddle point structure and resulting from discretizations of fluid problems. In the talk we review the approach and discuss some of its recent developments. In particular, we introduce the Augmented Lagrangian preconditioner for the algebraic systems of unfitted finite element discretizations of fluid equations posed on smooth closed surfaces. A matrix of the system features a sign-indefinite (2,2)-diagonal block with a high-dimensional kernel that requires special handling. We further consider a reuse of matrix factorization as a building block in the full and modified Augmented Lagrangian preconditioners. The strategy, applied to solve two-dimensional incompressible fluid problems, yields efficiency rates independent of the Reynolds number. The talk partially covers results from [3].

References

[1] M. Benzi and M. Olshanskii, An augmented Lagrangian approach to linearized problems in hydrodynamic stability, SIAM J. Sci. Comp. 30 (2005), pp. 1459–1473.
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