A TIME DEPENDENT TWO-PHASE STOKES PROBLEM: WELL-POSEDNESS AND SPACE-TIME FEM DISCRETIZATION

Igor Voulis

Institut für Geometrie und Praktische Mathematik,
RWTH-Aachen University,
Templergraben 55
D-52056 Aachen, Germany
e-mail: voulis@igpm.rwth-aachen.de

ABSTRACT

We consider a time dependent Stokes problem with a prescribed, sharp, moving interface. This problem has discontinuous density and viscosity coefficients, a pressure solution that is discontinuous across an evolving interface and an interfacial force (surface tension). This strongly simplified two-phase Stokes equation is a good model problem for the development and analysis of finite element discretization methods for two-phase flow problems. In view of the unfitted finite element methods that are often used for two-phase flow simulations, we are interested in a well-posed variational formulation of this Stokes interface problem in a Euclidean setting.

We discuss the derivation of such a variational formulation in suitable spaces of divergence free functions, as well as the discontinuous-in-time variational formulation involving the pressure variable for the divergence free constraint. This latter formulation is a natural starting point for a space-time finite element discretization with a Discontinuous Galerkin temporal discretization. By combining this DG time-stepping scheme with a spatial XFEM method, we obtain a fully discrete method which is capable of treating discontinuities.

REFERENCES

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