Preconditioners for Two-Phase Incompressible Navier-Stokes Flow

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Two-phase flows arise in many coastal and hydraulic engineering applications such as the study of coastal waves, dam breaking scenarios, and the design of coastal structures. However, modelling two-phase incompressible flow with a level set formulation results in a variable coefficient Navier-Stokes system that is challenging to solve computationally. Here we consider preconditioners for such systems, looking to adapt efficient preconditioners for single-phase flows. In particular we consider systems arising from the application of finite element methodology and preconditioners based on approximate block factorisation. A crucial ingredient is a good approximation to the Schur complement which can be computed efficiently. To do this, we develop two-phase variants of the pressure convection-diffusion (PCD) and least-squares commutator (LSC) preconditioners.

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