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A Filtering AMG Solver for Systems of PDEs

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Algebraic multigrid methods provide a useful tool for the solution of large sparse linear systems of equations with almost optimal complexity. In this talk we comment on the *Filtering Algebraic Multigrid* method and introduce its generalization for systems of coupled PDEs. In this class of methods the interpolation operator for coarse grid correction is constructed, such that the norm of the two-grid operator is minimized in an approximate sense. At the same time, additional filter conditions for certain test vectors can be imposed in order guarantee an exact interpolation of the near null space.

The developed method is finally applied to the problem class of density driven flow in porous media. This includes a fully nonlinear formulation as well as a simplified approximation of Boussinesq-type. In both cases additional challenges for the linear solver arise from anisotropies, discontinuous coefficients and fluctuations in the velocity profiles. We present a robust preconditioning strategy within a point-block-setting. This comprises the choice of appropriate smoothers, a pre-processing in the setup phase and modifications for the choice of strong connections.