A Robin–Robin Domain Decomposition Method for Stokes–Darcy Problems with Generalised Coupling Conditions

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Abstract

Coupled free-flow and porous-medium models appear in numerous environmental, industrial, and medical applications. Such flow problems are usually described by Stokes equations in the free-flow domain and Darcy's law in the porous medium. The choice of interface conditions plays a crucial role in accurately capturing the interaction between free flow and porous-medium flow. In this talk, we consider a generalisation of the classical Beavers–Joseph condition. Unlike the classical formulation, which is restricted to flows parallel to the fluid-porous interface, the generalised conditions are applicable for arbitrary flow directions.
To solve the resulting Stokes–Darcy models efficiently, we develop and analyse a Robin–Robin domain decomposition method for non-overlapping subdomains [1]. Fourier analysis is used to determine optimal weights in the Robin interface conditions. We investigate the efficiency and robustness of the proposed domain decomposition method and present numerical experiments that confirm the theoretical convergence results.

References

[1] P. Strohbeck, M. Discacciati, and I. Rybak, "Optimized Schwarz method for the Stokes–Darcy problem with generalized interface conditions", *J. Comput. Appl. Math.*, **477**, 117141, 2026. doi:10.1016/j.cam.2025.117141