Seminario de Análisis Numérico y Modelamiento Matemático SANMoMa - Estudiantes

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A Divergence-free method for the generalized Brinkman problem with variable viscosity

Miércoles 19 de agosto, 12:30 -13:30 horas

Auditorio 'Hermann Alder Weller'

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Abstract

We present an Iterated Penalty Method (IPM) for generalized Stokes problems with non-homogeneous Dirichlet boundary conditions. The method is formulated within the Scott–Vogelius finite element framework, while non-zero boundary data are imposed weakly through Nitsche's method. We first establish the well-posedness of the resulting finite element formulation and derive the corresponding approximation estimates. We then introduce the iterated penalty formulation and analyze its convergence, proving contraction properties of the iterative scheme and deriving error estimates for the resulting approximation. A key feature of the analysis is the study of the associated divergence equation, for which monotonicity properties provide the basis for the convergence analysis. The proposed approach preserves the pressure-robust character of the Scott–Vogelius discretization while avoiding the need to solve the fully constrained saddle-point problem at every iteration. Numerical experiments in two and three spatial dimensions illustrate the theoretical results, including the contraction behavior, approximation accuracy, and pressure robustness of the method. Finally, we extend the approach to a time-dependent problem and demonstrate its performance for transient Stokes Flow with non-homogeneous boundary conditions. The results show that the proposed IPM provides an effective and robust iterative alternative for incompressible flow problems with weakly imposed Dirichlet data.