Seminario de Estudiantes de Postgrado en Ingeniería Matemática

Sesión 5 - 2026

Miércoles 28 de octubre, 12:30 horas, auditorio Hermann Alder Weller, CI²MA

A Lagrange multiplier-based finite element method for a reverse osmosis model

In this talk, we present a Lagrange multiplier-based finite element method for a reverse osmosis model describing the flow of a saline solution through a channel bounded by semipermeable membranes. The mathematical model couples the incompressible Navier–Stokes equations with a convection–diffusion equation for the solute concentration, incorporating nonlinear membrane conditions that account for permeation and concentration polarization. We consider a velocity–pressure formulation for the fluid flow and a primal formulation for the concentration, while imposing Dirichlet-type boundary conditions weakly through Lagrange multipliers. Using a fixed-point strategy and the Banach fixed-point theorem, we establish the well-posedness of the continuous problem under suitable smallness assumptions on the data and prove the non-negativity of the concentration. We then introduce a Galerkin scheme and establish its well-posedness together with a Strang-type a priori error estimate. In particular, we show that a suitable combination of Taylor–Hood elements, continuous piecewise polynomials, and boundary Lagrange multipliers yields optimal convergence rates. Finally, numerical experiments confirm the theoretical results and illustrate the performance of the proposed method in a realistic reverse osmosis membrane channel.

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