

Bouchra Bensiali (talk 2): A d-dimensional fictitious domain penalization method for Neumann or Robin boundary conditions

Tuesday, June 10, 2025 11:15 AM (45 minutes)

In this talk, we present a d-dimensional extension of a fictitious domain penalization technique we previously proposed for Neumann or Robin boundary conditions. We apply Droniou's approach for non-coercive linear elliptic problems to prove existence and uniqueness of the penalized problem's solution. To establish convergence, we develop a boundary layer approach inspired by the Dirichlet case. However, unlike the Dirichlet setting where estimating remainders is straightforward, convergence here is reduced to the existence of suitable supersolutions of a dual problem. These supersolutions are then constructed as approximate solutions of the dual problem via an additional formal boundary layer approach. The proposed method leads to an advection-dominated problem, requiring numerical methods adapted to singular perturbation problems. We use upwind finite differences to validate the convergence rate and boundary layer thickness, confirming the theoretical predictions. Finally, we explore the potential of this method for problems posed on moving domains, such as those arising in population dynamics under climate change. This talk comprises joint work with Jacques Liandrat, Centrale Méditerranée, I2M.