MODELING, APPROXIMATION, AND ANALYSIS OF PARTIAL DIFFERENTIAL EQUATIONS INVOLVING SINGULAR SOURCE TERMS (MS - ID 39)

Finite element approximation of Stokes equations with non-smooth data

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The lid driven cavity flow is a well known model used frequently to test the finite element approximation of the Stokes problem. Actually, this model does not meet the regularity requirements for the boundary datum which is only in L^2, so that it cannot be the trace of the velocity which belongs to H^1. In this talk, we analyze the finite element approximation of the Stokes equations with nonsmooth Dirichlet boundary data. To define the discrete solution we first approximate the boundary datum by a smooth one and then apply a standard finite element method to the regularized problem. We prove almost optimal order error estimates for two regularization procedures in the case of general data in fractional order Sobolev spaces, and for the Lagrange interpolation (with appropriate modifications at the discontinuities) for piecewise smooth data. Our results apply in particular to the classic lid-driven cavity problem improving the existing error estimates.

Finally, we introduce and analyze an a posteriori error estimator. We prove its reliability and efficiency, and show some numerical examples which suggest that optimal order of convergence is obtained by an adaptive procedure based on our estimator.

The results reported in this talk have been obtained, in collaboration with Ricardo Duràn and Ariel Lombardi.