A posteriori estimates for hexahedral mixed finite elements

I. Ben Gharbia[1,2], J. Jaffré[1], and J.E. Roberts[1]

[1]*INRIA Paris-Rocquencourt, Rocquencourt, France*
[2]*Université de Paris 9 (Dauphine), Paris, France*

ABSTRACT:

In many domains of application grids made up of hexahedra are preferred for modeling flow and transport in porous media. In particular it is easier to follow geological layers with hexahedra than with rectangular solids. In addition, unlike grids of tetrahedra, grids of hexahedra are structured in a natural way. Numerical models based on mixed finite elements have many properties that make them especially appropriate for flow models: they produce an approximation to the Darcy flux as well as to the pressure and they are locally conservative. However, the classical mixed finite elements of Raviart-Thomas-Nedelec do not give satisfactory results for hexahedral grids. Sboui, Jaffré and Roberts studied a mixed finite element method for hexahedral grids based on ideas of Kuznetsov and Repin. The elements used in this method were composite elements with a subdivision of the hexahedron into five tetrahedra.

While a priori error estimates give an indication of the rate of convergence of a method, a posteriori error estimates provide an estimation of the error committed in a particular numerical calculation. These make it possible to know which part of the domain gives rise to the largest part of the error and where further computational effort could be most effectively applied. Many methods have been suggested for calculating a posteriori estimates for mixed methods. In this talk we present a posteriori error estimates for the above hexahedral mixed finite elements. These estimates are based on work of Vohralik and emphasize velocity errors. Numerical results will be shown