

Mimetic Finite Differences: new results and perspectives

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The talk will overview the basic features of Mimetic Finite Difference Methods.

The method, rather recent, can be considered as intermediate between Finite Volumes and Mixed Finite Element Methods.

The first part of the presentation will be carried out at a quite general level. We shall consider spaces of cochains associated with very general decompositions of the computational domain in elements of almost arbitrary geometry. We will then underly the role of such cochains for the approximation of differential forms, and we will point out the necessity to introduce suitable scalar products in these cochain spaces.

In the second part we will show in more detail the use of these scalar products, taking as an example Darcy 's law for the filtration of fluids in porous media. There we shall go into more details, presenting the basic ideas that allowed the extension of the method to a very wide class of geometrical situations, including polyhedra with curved faces. We will present optimal error estimates for both pressure and velocities (fluxes), and some super-convergence estimates for the pressure based on the idea of *virtual reconstructions* of fluxes inside the elements.

This last part will be based on several papers written in collaboration with K. Lipnikov and M. Shashkov from Los Alamos N.L. and V. Simoncini from the University of Bologna.