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HERMITE FINITE ELEMENTS WITH NORMAL FLUX CONTINUITY

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This work addresses some techniques based on Hermite interpolation, to solve second order partial differential equations describing different phenomena, in which quantities represented by normal fluxes play an important role. Among them lie the Darcy equations for flow in porous media, or convection-diffusion equations in divergence form or not. The basic idea is to use the fluxes over edges or faces as degrees of freedom, besides suitable values of the primal variable. In this manner it is easy to enforce the required continuity of the fluxes across inter-element boundaries. Two types of simplex finite elements are studied. One of them is an extension of the piecewise complete quadratic Hermite element introduced in [1], to the case of the convection-diffusion equations. The other one is the Hermite analog of the extension to the same problem of the celebrated lowest order Raviart-Thomas mixed finite element, known as RT0, for pure diffusion problems. This analog is described in [2] for the case of the non divergence form of these equations. The method studied here can be viewed as a non trivial improved version of the RT0's variant proposed by Douglas and Roberts for the convection-diffusion equations in divergence form [3]. In contrast to the mixed methods, the approximation of the primal variable attains the second order in the mean square sense, for both Hermite approaches. Comparative numerical results illustrate the properties and the performance of the new methods.

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