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**Shape functions for velocity interpolation in general hexahedral cells.** (English)

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Summary: Numerical methods for grids with irregular cells require discrete shape functions to approximate the distribution of quantities across cells. For control-volume mixed finite-element (CVMFE) methods, vector shape functions approximate velocities and vector test functions enforce a discrete form of Darcy's law. In this paper, a new vector shape function is developed for use with irregular, hexahedral cells (trilinear images of cubes). It interpolates velocities and fluxes quadratically, because as shown here, the usual Piola-transformed shape functions, which interpolate linearly, cannot match uniform flow on general hexahedral cells. Truncation-error estimates for the shape function are demonstrated. CVMFE simulations of uniform and non-uniform flow with irregular meshes show first- and second-order convergence of fluxes in the  $L^2$  norm in the presence and absence of singularities, respectively.

**MSC:**

[76M10](#) Finite element methods applied to problems in fluid mechanics

[76S05](#) Flows in porous media; filtration; seepage

Cited in **14** Documents

**Keywords:**

[control-volume method](#); [CVMFE method](#); [distorted grid](#); [hexahedral grid](#); [local Darcy law](#); [local mass conservation](#); [mixed method](#); [Piola transformation](#); [vector shape function](#); [3-D](#)

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