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Discretization of incompressible vorticity-velocity equations on triangular meshes. (English)

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Summary: This paper describes a new approach to discretizing first- and second- order partial differential equations. It combines the advantages of finite elements and finite differences in having both unstructured (triangular/tetrahedral) meshes and low-order physically intuitive schemes. In this "co-volume" framework, the discretized gradient, divergence, curl, (scalar) Laplacian, and vector Laplacian operators satisfy relationships found in standard vector field theory, such as a Helmholtz decomposition. This article focuses on the vorticity-velocity formulation for planar incompressible flows. The algorithm is described and some supporting numerical evidence is provided.

MSC:

76D05 Navier-Stokes equations for incompressible viscous fluids
76M10 Finite element methods applied to problems in fluid mechanics
76M20 Finite difference methods applied to problems in fluid mechanics

Keywords:

second-order partial differential equations; finite elements; finite differences; discretized gradient; vector Laplacian operators; Helmholtz decomposition; vorticity-velocity formulation for planar incompressible flows

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