

# The Face-Centred Finite Volume Methods for Incompressible Flows

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## ABSTRACT

The Face-Centred finite volume (FCFV), which stems from a mixed-formulation of the Discontinuous Galerkin (DG) methods, is presented for the incompressible Navier-Stokes equations. The main feature of the FCFV formulation is the definition of the solution at the centre of cell faces. In contrast, existing Cell-Centred (CCFV) and Vertex-Centred (VCFV) finite volume formulations available in many CFD require the reconstruction of gradients at the cell faces. As a consequence, those technologies experience suboptimal convergence when the grid is distorted or stretched [4-6]. On the contrary, the FCFV achieves first-order accuracy for the solution and its gradient without the need of flux reconstruction. Hence, FCFV preserves its accuracy irrespective of grid stretching or distortion [1-3]. From an industrial perspective, this flexibility in mesh generation is a critical aspect in face of the complex geometric configurations to be studied in CFD problems. Furthermore, the FCFV formulation naturally circumvents the need for pressure correction strategies to deal with the velocity-pressure coupling in incompressible flow problems. The capabilities of the FCFV for the simulation of incompressible Navier-Stokes equations will be presented via numerical experiments involving both academic and industrial benchmarks.

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