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A robust control volume finite element method for high aspect ratio domains with dynamic mesh optimisation PABLO SALINAS, DIMITRIOS PAVLIDIS, Imperial College London, ZHIHUA ZIE, Cardiff University, CARL JACQUEMYN, CHRISTOPHER PAIN, MATTHEW JACKSON, Imperial College London — It can be challenging to produce good quality meshes for models of heterogeneous porous media as domains can have very large aspect ratio and/or complex geometries. Here, a novel control volume finite element method (CVFEM) for simulating multi-phase flow in heterogeneous porous media with highly distorted meshes is presented. In this new formulation, velocity and saturation are discretised as in the classical CVFEM, whereas pressure is discretised using control volumes. The use of control volumes to discretise the pressure creates a pressure matrix that converges very efficiently even when large angle elements are present in the mesh. Heterogeneous geologic features are represented as volumes bounded by surfaces. Our approach conserves mass and the method converges efficiently using highly anisotropic meshes. Results are presented showing the robustness of the presented method for a set of highly heterogenenous and complex geometries, showing very high aspect ratio elements, and using the iterative solvers provided in PETSc. The novel control volume representation for pressure creates a pressure matrix that can be solved very efficiently independently of the elements shapes appearing in the domain, which is key when using dynamic mesh optimisation or high aspect ratio domains.

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