Nonlinear Discretizations on Polyhedral Meshes for Subsurface Multi-Phase Flows: Approximation, Monotonicity and Near-well Correction

Yuri Vassilevski, Kirill Nikitin, Konstantin Novikov, Vasily Kramarenko

Institute of Numerical Mathematics, Russian Academy of Sciences

Abstract

We consider approaches to the design of a monotone cell-centered finite volume discretization of convection-diffusion equations describing multiphase flows. The cornerstone of the approaches is the nonlinear discretization of fluxes derived on faces of mesh cells. The permeability tensor may be heterogeneous, full and essentially anisotropic. The computational mesh is assumed to consist of convex polyhedral cells. The schemes possess the minimal stencil containing the closest neighboring cells only. The near-well correction takes into account a nonlinear (e.g. logarithmic) singularity of the pressure in the near-well region and improves accuracy of the pressure and the flux calculation.

REFERENCES

1. Nikitin K., Vassilevski Yu. A monotone nonlinear finite volume method for advection–diffusion equations on unstructured polyhedral meshes in 3D. *Russian J. Numer. Anal. Math. Modelling*, V.25, No.4, pp.335-358, 2010

2. Lipnikov K., Svyatskiy D., Vassilevski Yu. Minimal stencil finite volume scheme with the discrete maximum principle. *Russian J. Numer. Anal. Math. Modelling*, V.27, No.4, pp.369-385, 2012

3. Chernyshenko A., Vassilevski Yu. A finite volume scheme with the discrete maximum principle for diffusion equations on polyhedral meshes. *Finite Volumes for Complex Applications VII-Methods and Theoretical Aspects.* Springer International Publishing, pp.197-205, 2014.

4. Nikitin K., Terekhov K., Vassilevski Yu. A monotone nonlinear finite volume method for diffusion equations and multiphase flows. *Comp.Geosciences*, V.18, No.3, p. 311-324, 2014

5. Nikitin K., Kramarenko V., Vassilevski Yu. A finite volume scheme with improved well modelling in subsurface flow simulation. *Comp.Geosciences*, 2017, to appear.