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A really pressure-robust virtual element method for the Stokes problem

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Virtual element methods can be seen as modern approach to extend finite element methods to polygonal and polyhedral meshes. For the Stokes problem recently a very popular and elegant approach was presented in [BdVLV17] which exactly preserves the divergence constraint of the velocity field on the discrete level.

Usually, conforming divergence-free methods are pressure-robust in the sense that adding gradients to the momentum balance or decreasing the viscosity does not effect the discrete velocity; see [JLM+17] for more information about pressure-robustness. Unfortunately, this is not the case for the above mentioned method [FM20].

This talk presents results from [FM20] and shows how to repair the lack of pressure-robustness. To this extend, a modification of the VEM is presented based on Raviart–Thomas approximations of the test functions which renders the method really pressure-robust, i.e. locking free for very small viscosities. The construction is also interesting for hybrid high-order methods on polygonal or polyhedral meshes. Numerical results round up the theoretical findings.

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