

Higher order discontinuous Galerkin methods in time and pressure-robust finite element discretizations applied to time-dependent generalized Stokes problems

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We consider discretizations of the time-dependent generalized Stokes equations based on pressure-robust inf-sup stable finite element methods in space and discontinuous Galerkin time-stepping schemes. Pressure robustness is ensured by using a reconstruction operator on the right-hand side, for the time derivative and in the reactive term. This ensures error estimates for the velocity that are completely independent of the pressure and, in particular, its smoothness. For a temporal interpolant of the right-hand side, we prove optimal convergence orders in space and time for both velocity and pressure. Furthermore, this temporal interpolant allows to perform two cheap post-processing steps in time that lead to an increased temporal accuracy, two orders for velocity and one order for pressure. Again, the velocity error constants are independent of the pressure. Numerical examples illustrate our theoretical results.

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