Numerical challenges and techniques for higher order temporal discretizations applied to time-dependent generalized Stokes problems

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When Galerkin time-stepping schemes and pressure-robust inf-sup stable finite element methods are applied to discretize time-dependent generalized Stokes equations, they yield a characteristic block-wise structure of the discretized system of equations. With increasing discretization order in time, these systems tend to be numerically ill-conditioned. We discuss strategies how to overcome that, especially by using a proper basis representation to calculate numerically precise coefficients of the time-stepping scheme. Additionally, we make use of the characteristic structure of the system matrix to reduce the computational effort. This is particular useful for higher order discretizations, where the system size tends to become quite large.

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