On an initial higher-order pressure convergence in equal-order finite element discretisations of the Stokes system

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The finite element discretisation of pressure and velocity in incompressible flow systems can be done via either stable spaces or stabilised pairs. Even for some stable elements, however, the classical theory guarantees only linear convergence for the pressure approximation, although a higher order is often observed in practice. Such experimental observations may, in the absence of a sound a priori error analysis, mislead the selection of discretisation spaces in practical applications. Therefore, in this contribution we present a numerical analysis having a Schur complement system as an abstract setting and the MINI element as a main concrete example. Our theory demonstrates that an initial higher-order pressure convergence may in fact occur under certain conditions, but whether and for how long this holds may depend on the problem and the discretisation.

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