Mixed finite element for Stokes eigenvalue problem

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In this talk, we present a novel three-field finite element for the Stokes eigenvalue problem. To this end, we approximate the Hellinger-Reissner (mixed) formulation where the symmetry of the stress tensor σ is dealt with in a weak form by introducing a Lagrange multiplier that represents the conservation of angular momentum. We consider the space of tensors whose rows consist of an element of RT_k space for the stress, the space of discontinuous piecewise linear vectors for the velocity, and the space of skew-symmetric continuous piecewise linear tensors to impose the symmetry weakly. We end up with a stress-velocity-vorticity formulation discretized with $RT_k^d - DP_k^d - P_k^{\frac{d(d-1)}{2}}$, where $k \geq 1$. This formulation has notable benefits, as it directly arises from the fundamental physical principles of momentum balance, constitutive law, and mass conservation. Moreover, it provides a direct presentation of stress, which is particularly crucial in certain applications. Numerical examples in both convex and non-convex two and three dimensional domains are presented to illustrate the efficiency of the proposed methodology.

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