Report on the 2D Paper

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Aim of the paper

1. To determine α_{R} and β_{R} for different FEM methods of different FEM packages for various 2D second-order problems.
2. To choose FEM methods/elements that give smaller round-off error, i.e. α_{R} and β_{R}.
3. To apply the strategy in the 1D paper to find the optimal number of DoFs of 2D problems*.

Problem statement

We solve the problem as follows:

$$-\nabla \cdot (d(x, y)\nabla u) + \mathbf{a}(x, y) \cdot \nabla u + r(x, y)u = f, \qquad (x, y) \in \Omega = [0,\, 1] \times [0,\, 1], \tag{1}$$

where $d(x, y)$, $\mathbf{a}(x, y)$ and $r(x, y)$ are scalar/vector coefficient functions. The dependent variable u and coefficients can be either real-valued or complex-valued if not stated otherwise. By choosing different coefficient functions, we can have Poisson, diffusion or Helmholtz problems.

Progress

- Coefficients for the first derivative in Eq. (1), i.e. $a(x, y)$ and $b(x, y)$ considered for problems with real-valued solutions using the standard FEM. The solution using the mixed FEM is not correct by now, since the function space involved with u is not satisfied.

Future work

- To clarify the existence of the derivative of interest.
- To only show the error of $H(div)$ for the second derivative using the mixed FEM.