# Mixed hp-adaptive FEM of the eddy current model

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We are interested in the electromagnetic field generated by an alternating current density, in the computational domain $\Omega$ with dielectric media. In many situations the quasi-static eddy current model is reliable. The $E$-field is determined in $H(\text{curl}, \Omega)$ only up to gradients of potential functions $\phi$ in $H^1(\Omega_0)$, where $\Omega_0$ is the sub-domain of non-conducting materials. However, by introducing additional constraints a uniquely solvable mixed formulation for $E$ and $\phi$ in $H(\text{curl}, \Omega) \times H^1(\Omega_0)$ results.

The space $H(\text{curl}, \Omega) \times H^1(\Omega_0)$ is discretised by $W \times S$, consisting of fully hp-adaptive edge and nodal element spaces on a quadrilateral mesh. To ensure unique solvability of the discrete problem the space of the discrete gradients of the potentials have to coincide with the kernel of the discrete curl operator applied to $W$. This implies relations of the polynomial degrees of $W$ and $S$ and enforces a so-called minimum rule.

The talk focuses on developing an algorithm, which delivers small supported basis functions satisfying the minimum rule.

In the presented numerical results interface effects are accurately resolved by anisotropic polynomial degrees and non-conforming meshes at low computational costs. Extension to three dimensions and other mixed formulations follows similarly.

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