Gauging strategies for high order finite element discretizations of Maxwell's equations

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In order to guarantee unique solvability for magnetostatic Maxwell's equations additional constraints, so called gauging conditions, have to be imposed. In particular, we consider Coulomb gauge which enforces orthogonality to gradient fields and discuss several realizations, e.g. via Lagrange multipliers.

By a careful construction of high order Nedelec-type finite elements the Coulomb gauge can be realized by a two step strategy: First, uniqueness of the discrete magnetostatic problem can be ensured by eliminating part of the high order basis functions (and appropriate handling of the low order space). In a second step the orthogonality to gradients is restored by postprocessing.

Both subproblems use reduced bases and are better conditioned than the original problem, so the overall performance can be improved considerably. The efficiency of our approach is illustrated by numerical examples.

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