A tree-cotree technique for the approximation of the spectrum of the curl operator

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Talk Abstract

We present a new algorithm for the finite element approximation of the eigenvalue problem for the curl operator in a multiply-connected domain Ω. In a simply-connected domain the curl operator is self-adjoint when restricted to the space of vector fields $\mathbf{v}$ that satisfy the boundary condition $\operatorname{curl}\mathbf{v}\cdot\mathbf{n}=0$. When Ω is multiply-connected additional constraints must be imposed: a viable choice is the vanishing of the line integrals of $\mathbf{v}$ on suitable homological cycles lying on the boundary (see [1]). The new algorithm that we propose is based on the weak formulation and finite element approximation of this problem analyzed in [2]. The algorithm exploits the Hodge decomposition of the finite element space and a tree-cotree decomposition of the graph relating the degrees of freedom of the Lagrangian finite elements and those of the first family of Nédélec finite elements to significantly reduce the dimension of the algebraic eigenvalue problem to be solved.

Keywords: Spectrum of curl operator, Multiply connected domain, Edge elements, Tree-cotree decomposition.

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