HDG Method for the 3d Frequency-Domain Maxwell's Equations With Application to Nanophotonics

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Abstract

HDG method is a new class of DG family with significantly less globally coupled unknowns, and can leverage a post-processing step to gain super-convergence. Its features make HDG a possible candidate for computational electromagnetics applications, especially in the frequency-domain. The HDG method introduces an hybrid variable, which represents an additional unknown on each face of the mesh, and leads to a sparse linear system in terms of the degrees of freedom of the hybrid variable only. In [1], we have introduced such a HDG method for the system of 3d time-harmonic Maxwell's, combined to an iterative Schwarz domain decomposition (DD) algorithm to allow for an efficient parallel hybrid iterative-direct solver. The resulting DD-HDG solver has been applied to classical applications of electromagnetics in the microwave regime. Recently, this HDG method has been extended to the solution of the 2d frequency-domain Maxwell's equation coupled to different models of physical (local and non-local) dispersion in metals with application to nanoplasmonics[2]. In the present contribution, we further focus on this particular physical context and propose a arbitrary high order HDG method for solving the system of 3d frequency-domain Maxwell equations coupled to a generalized model of physical dispersion in metallic nanostructures at optical frequencies. Such a generalized dispersion model unifies most common dispersion models, like Drude and Drude-Lorentz models, and it permits to fit large range of experimental data. The resulting DD-HDG solver is capable of using different element types and orders of approximation, hence enabling the possibilities of *p*-adaptivity and non-conforming meshing, and proves to have interesting potentials for modeling of complex nanophotonic and nanoplasmonic problems.

References

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