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A Hybrid High-Order Method for the Indefinite Time-Harmonic Maxwell Problem

Matteo Cicuttin[1*] and Christophe Geuzaine[1]

[1] University of Liège, Montefiore Institute, Allée de la Découverte 10, 4000 Liège,
`matteo.cicuttin@uliege.be`

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Hybrid High-Order (HHO) methods are recent discontinuous skeletal, fully polyhedral schemes for the numerical solution of PDEs which are widely deployed in computational mechanics [1]; recently they were applied also to magnetostatics [2]. In this work we devise a method for the time-harmonic indefinite Maxwell problem and we apply it to the simulation of a real-world microwave device in order to study reflection coefficients.

HHO methods attach discrete unknowns to both the mesh cells faces. In the present case, cell unknowns are polynomials with values in $\mathbb{C}^3$ whereas face unknowns are polynomials with values in $\mathbb{C}^2$ tangent to the considered face. An element-local reconstruction then uses these polynomials to compute a new function on the cell. Moreover, an element-local stabilization enforces weakly tangential continuity on the element boundaries by penalizing the difference between the face function and the tangential component of the cell function. This local construction enables the elimination of cell unknowns during assembly via a local Schur complement. Finally, plane wave sources and Total/Scattered field decompositions allow for a broad range of electromagnetic simulations.

Being skeletal, HHO provides significant computational advantages over classical SIP-DG, especially in term of memory utilization. As the time-harmonic Maxwell problem in many cases requires to be solved with direct solvers, this is an important advantage. Below, we compare the resource utilization of the PARDISO solver deployed on HHO and SIP-DG.

	HHO		SIP-DG	
Degree	Memory	Mflops	Memory	Mflops
k=1	0.5 Gb	8.723	0.3 Gb	20.040
k=2	0.9 Gb	66.759	2.4 Gb	313.133
k=3	2.6 Gb	309.072	9.3 Gb	2.560.647

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