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A High-Order Runge-Kutta Discontinuous Galerkin Method for Solving Time-Domain Maxwell's Equations

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ABSTRACT

In this talk, we present a high-order Runge-Kutta Discontinuous Galerkin (RKDG) method to solve the time-domain Maxwell's equations in three dimension. The framework was proposed in [1] and the scheme achieves full high-order convergence in time and space while keeping the time-step proportional to the spatial mesh-size.

The computation domain Ω is divided into hexahedral elements, possibly curvilinear ones, and, on each element K, we take the polynomial space, Q^k, as the local space. Then, we can use the discontinuous Galerkin methods to approximate the Maxwell's equations and the resulting semi-discrete equation is a system of ordinary equations. To treat the curvilinear hexahedral elements, we use transfinite blending functions, [2], to construct a coordinate mapping between the curvilinear hexahedral element K and a straight side cube I^3. Then we can change the semi-discrete equation into the curvilinear setting.

Since the basis functions of the local space Q^k can be construct easily, we can construct any high-order spatial discretization. For the time-integration scheme, to maintain the same order of accuracy, we implement the mth-order, m-stage strong stability preserving Runge-Kutta (SSP-RK) scheme presented in Gottlieb et al. [3]. However, for explicit time-varying boundary conditions, the resulting ordinary system is inhomogeneous and the technique presented in Chen et al. [1] is used to maintain the same order of accuracy.

Numerical results are presented that confirm the predicted convergence properties.

REFERENCES

[1] M.-H. Chen, B. Cockburn and F. Reitich, "High-Order RKDG methods for computational electromagnetics". *J. Sci. Comput*. Vol. **22/23**, 205–226, 2005.

[2] W. Gordon, and C. A. Hall, "Transfinite Element Methods: Blending-Function Interpolation over Arbitrary Curved Element Domains", *Numerische Mathematik*, Vol. **21**, 109–129, 1973.

[3] S. Gottlieb, C.-W. Shu, and E. Tadmor, "Strong stability preserving high order time discretization methods". *SIAM Rev.*, Vol. **43**, 89–112, 2000.