High-Order RKDG Methods for Computational Electromagnetics

Min-Hung Chen

mhchen@math.ncku.edu.tw
Department of Mathematics
National Cheng-Kung University
Tainan, Taiwan

In this talk, we devise a new Runge-Kutta Discontinuous Galerkin (RKDG) method that achieves full high-order convergence in time and space while keeping the time-step proportional to the spatial mesh-size. To this end, we derive an extension to non-autonomous linear systems of the mth-order, m-stage strong stability preserving Runge-Kutta (SSP-RK) scheme with low storage described in Gottlieb et al. [2]. With this time-integration scheme, and if polynomials of degree k are used in the space discretization, our RKDG method can be made to converge with overall order $m = k + 1$, for any $k > 0$. In particular, the scheme allows for a high-order accurate treatment of the inhomogeneous (time-dependent) terms that enter the semi-discrete problem on account of the physical boundary conditions. Therefore, we can implement the exact non-reflecting boundary conditions derived by Grote, Keller [3] and Sofronov [4]. Numerical results in two space dimensions 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. **22/23** (2005), 205-226.

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

[3] M. Grote and J. Keller, *Nonreflecting boundary conditions for Maxwell's equations*, J. Comput. Phys. **139** (1998), 327-342.

[4] I. Sofronov, *Artificial boundary conditions of absolute transparency for two- and three- dimensional external time-dependent scattering problems.* Euro. J. Appl. Math. **9**, 1998, 561-588.