Fakultät für Mathematik

Forschungsschwerpunkt Partielle Differentialgleichungen

Karlsruher PDE-Seminar

Some recent developments of a non-dissipative DGTD method for time-domain electromagnetics

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Nowadays, a variety of modeling strategies exist for the computer simulation of electromagnetic wave propagation in the time domain. Despite a lot of advances on numerical methods able to deal accurately and in a flexible way with complex geometries through the use of unstructured (non-uniform) discretization meshes, the FDTD (Finite Difference Time Domain) method is still the prominent modeling approach for realistic time domain computational electromagnetics, in particular due to the possible straightforward implementation of the algorithm and the availability of computational power. In the FDTD method, the whole computational domain is discretized using a structured (Cartesian) grid. This greatly simplifies the discretization process but also represents the main limitation of the method when complicated geometrical objects come into play. Besides, the last 10 years have witnessed an increased interest in so-called DGTD (Discontinuous Galerkin Time Domain) methods. Thanks to the use of discontinuous finite element spaces, DGTD methods can easily handle elements of various types and shapes, irregular non-conforming meshes, and even locally varying polynomial degree, and hence offer great flexibility in the mesh design. They also lead to (block-) diagonal mass matrices and therefore yield fully explicit, inherently parallel methods when coupled with explicit time stepping. Moreover, continuity is weakly enforced across mesh interfaces by adding suitable bilinear forms (often referred as numerical fluxes) to the standard variational formulations. This talk will be concerned with some ongoing studies aiming at improving the accuracy and the performances of a non-dissipative DGTD [Fezoui et al., 2005] for the simulation of time-domain electromagnetic wave propagation problems involving general domains and heterogeneous media. The general objective is to bring the method to a level of computational efficiency and flexibility that allows to tackle realistic applications of practical interest. We will in particular discuss about some recent developments concerning the application of the method to nanophotonics applications.

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Gastgeber: Die Dozenten des Schwerpunkts Partielle Differentialgleichungen