Internship proposal (Master 2)

Inria Sophia Antipolis-Méditerranée
Acumes and Nachos project-teams

Spring 2017

Investigation of the sensitivity equation method for the 2D time-domain Maxwell equations

Context

The Nachos team at Inria Sophia Antipolis-Méditerranée has an expertise in the construction of high-order discretization schemes, based on Discontinuous Galerkin formulations, for electromagnetic wave propagation modeled by the system of Maxwell equations. This approach allows to achieve highly accurate simulations in a computationally efficient framework. From the application point of view, the team currently concentrates its efforts on the numerical modeling of nanoscale light/matter interaction problems (nanophotonics). In this emerging context, the extension of the developed methods to optimization and uncertainty quantification strategies is now targeted.

The Acumes project-team is specialized in optimization methods for systems governed by partial differential equations. Recent results have demonstrated the efficiency of the sensitivity equation method to estimate the derivatives of PDE solutions with respect to control parameters, in the context of hyperbolic time-dependent systems.

Description

The objective of the proposed work is to investigate the sensitivity equation method for the system of time-domain Maxwell equations in two dimensions, in the perspective of the development of optimization and uncertainty quantification strategies to be applied to the study of nanostructured devices.

Starting from an existing Discontinuous Galerkin (DG) method solving the 2D time-domain Maxwell equations, a first part of this internship will aim at establishing the corresponding sensitivity equations and discretizing them in a DG-compliant way. Two types of control parameters will be considered for the sensitivity analysis: the parameters that rule the constitutive or material laws (electric permittivity, magnetic permeability), and geometrical parameters characterizing the nanostructures involved in the selected test problems. In a second part, some numerical tests will be performed to assess the accuracy of the sensitivity solutions for the different parameters and apply the derivatives to optimization problems (e.g. shape optimization) and uncertainty quantification (e.g. uncertainty in constitutive parameters).

Requirements

- Master 2 level (or equivalent) in applied mathematics or scientific computing
- Basic skills in programming, experience in Fortran will be appreciated

Practicalities

- Salary net per month: about 540€
- Duration: 6 months
- Location: Inria Sophia Antipolis-Méditerranée research center

Contacts

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