Discontinuous Galerkin method for time-domain Maxwell's equations in anisotropic materials

Adérito Araújo
CMUC, Department of Mathematics, University of Coimbra, Portugal.
alma@mat.uc.pt

Sílvia Barbeiro
CMUC, Department of Mathematics, University of Coimbra, Portugal.
silvia@mat.uc.pt

Maryam Khaksar Ghalati
CMUC, Department of Mathematics, University of Coimbra, Portugal.
maryam@mat.uc.pt

Abstract

In this talk we discuss the numerical discretisation of the time-dependent Maxwell's equations using a fully explicit leap-frog type discontinuous Galerkin method. We present a sufficient condition for the stability and error estimates, for cases of typical boundary conditions, either perfect electric, perfect magnetic or first order Silver-Müller. The bounds of the stability region point out the influence of not only the mesh size but also the dependence on the choice of the numerical flux and the degree of the polynomials used in the construction of the finite element space, making possible to balance accuracy and computational efficiency. In the model we consider heterogeneous anisotropic permittivity tensors which arise naturally in many applications of interest.

After providing numerical results that support the theoretical analysis, we present a methodology to assess cell level alterations on the human retina responsible for functional changes observable in the Optical Coherence Tomography data in healthy ageing and in disease conditions, in the absence of structural alterations.

Keywords: Discontinuous Galerkin method, stability and convergence, optical coherence tomography.