Error analysis of discontinuous Galerkin methods for time-dependent Maxwell equations

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Abstract. A semi-discrete DG method for the numerical approximation of time-dependent Maxwell equations in three different dispersive media is introduced. Both the $L^2$-stability and error estimates of the DG method are discussed in detail. We show that the proposed method has an accuracy of $O(h^{k+\frac{1}{2}})$ under the $L^2$-norm when polynomials of degree $k$ in space are used. Further, we introduce and analyze a fully discrete discontinuous Galerkin method for solving time-dependent Maxwell equations. Distinguished from the RKDG and FETD methods, the discontinuous finite element method is used for the discretization of temporal domain. Both $L^2$-stability and an error estimate of order $O((\Delta t)^{k+1} + h^{k+1/2})$ are proved under the standard finite element framework. Compared with FETD method, we obtain a high order error estimate in temporal domain.

Keywords: Discontinuous Galerkin method; Maxwell equations; Dispersive media; Plasma; Debye medium; Lorentz medium