A new efficient non-spurious 3D DG-FETD for large and multiscale electromagnetic systems

Luis E. Tobón [1,2], Qiang Ren[1], and Qing H. Liu*[1]

[1] Department of Electrical and Computer Engineering, Duke University, Box 90291, Durham, NC 27708

[2] Departamento de Ingeniería Electrónica y Ciencias de la Computación, Pontificia Universidad Javeriana, Cali, Colombia

The discontinuous Galerkin finite-element time-domain (DG-FETD) method is useful in transient simulations of multiscale electromagnetic systems. Its special capability in geometric modeling, by dividing the computational domain in several domains, transforms a large system into several moderate-sized matrix equations. The numerical fluxes, which communicate fields between domains, are defined by tangential components of **E** and **H** on the interfaces; for this reason, the conventional DG-FETD is traditionally based on these two variables.

This conventional DG-FETD method requires curl-conforming basis functions (e.g. the first family of the Nedelec elements) with different orders of interpolation to represent **E** and **H**, in order to suppress spurious solutions (Luis Tobón, Jiefu Chen, Qing H. Liu, Journal of Computational Physics, Volume 230, Issue 19, p. 7300-7310. 2011). Despite the higher order of interpolation in one field, the accuracy of the method is defined by the lower order with costly consequences in memory consumption, i.e. the number of unknowns of one field is several times higher than the other field.

In this work, we present a new approach for implementing DG-FETD based on **E** and **B** fields, which use curl-conforming and divergence-conforming basis functions, respectively, with same order of interpolation. In this way, higher accuracy and lower memory consumption are obtained with respect to the conventional approach. The centered flux is used to treat interfaces with non-conforming meshes, and the leapfrog method is used for time integration. Numerical examples will be presented to verify that the proposed method is a non-spurious and efficient DG-FETD scheme.