2D and 3D Forward modeling of electromagnetic fields in the time domain using Discontinuous Galerkin Method and Spectral Element Method.

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SUMMARY

Electromagnetic methods in the time domain have been widely used in geophysics exploration, and their application in complex media increases the necessity to get better forward and inverse modeling. With the increase of computational power, we can create more extensive and complex earth models and use more sophisticated numerical algorithms.

The boundary conditions of the electromagnetic problem dictate that the tangential electric field must be continuous, and the normal electric field is discontinuous. Thus, the finite element method based on nodal elements is unsuitable for this problem. An alternative is to use the Discontinuous Galerkin method, where the discontinuity of the normal electric field is preserved, and the jump in the tangential electric field is penalized for continuity.

This ongoing research project explores the spectral element method and the interior-penalty discontinuous Galerkin method (IP-DGM) to model transient electromagnetic fields in two and three dimensions in anisotropic media. IP-DGM allows us to have better control over the boundary conditions of the electromagnetic fields; furthermore, it is a highly parallelizable method and allows adaptation to geometries and complex boundary conditions. Finally, we tested explicit schemes such as finite differences, the Lax-Wendroff method, and the Backward Euler implicit method for time stepping.

Keywords: Discontinuous Galerkin Method, Time-domain, Electromagnetic fields.