Luz Angelica Caudillo Mata

A Multiscale Finite Volume Method for Geophysical Electromagnetic Simulations in Time Domain

4013-2207 Main Mall
Vancouver B C
V6T 1Z4
lcaudill@eos.ubc.ca
Eldad Haber

Efficient and accurate simulation of transient electromagnetic fields and fluxes of complex geological settings is crucial in a variety of scenarios, including mineral and petroleum exploration, water resource utilizations and geothermal power extractions. In this talk, we present a new Multiscale finite volume method that computes these electromagnetic responses in a very effective manner.

Geophysical time-varying electromagnetic simulations of highly heterogeneous media are computationally expensive. One reason for this is the fact that very fine meshes are often required to accurately discretize the physical properties of the media, which may vary over a wide range of length scales and several orders of magnitude. Using very fine meshes for the discrete models lead to solve large systems of equations that are often difficult to deal with at each time step.

To reduce the computational cost of the electromagnetic simulation, we develop a Multiscale finite volume method for the quasistatic Maxwells equations in the time domain. Our method begins by locally computing Multiscale basis functions at each time step, which incorporate the small-scale information contained in the physical properties of the media. Using a Galerkin proper orthogonal decomposition approach, the local basis functions are used to represent the solution on a coarse mesh. The governing equations are numerically integrated using an implicit time marching scheme.

Our approach leads to a significant reduction in the size of the final system of equations to be solved and in the amount of computational time of the simulation, while accurately approximating the behavior of the fine-mesh solutions. We demonstrate the performance of our method in the context of an airborne geophysical application.