LUZ ANGELICA CAUDILLO MATA, University of British Columbia

Multiscale and Upscaling Methods to Simulate Geophysical Electromagnetic Responses

Accurate and efficient simulation of electromagnetic (EM) responses in large-scale settings with highly heterogeneous media and features varying at multiple spatial scales is crucial to the exploration and imaging of geological formations in a wide range of geophysical applications. One major challenge in practice to perform this type of simulation is the excessive computational cost it involves. This cost comes from solving a giant system of equations that results from the discretization of this type of large-scale settings, which often require very detailed meshes.

Multiscale and Upscaling finite volume (FV) and finite element (FE) techniques have been extensively studied in the field of modeling flow in heterogeneous porous media, where they have been successfully used to drastically reduce the size of the linear system while producing accurate solutions similar to that obtained with FE or FV discretization schemes on a fine mesh. Recognizing the success that these techniques have had in fluid flow applications, we extended their use for application in EM modeling. Specifically, we developed an upscaling framework and a multiscale FV with oversampling method for the quasi-static Maxwell's equations in the frequency domain.

In this talk, we discuss the two methods we propose and show a comparison of the upscaling framework with the multiscale FV method with and without oversampling for a synthetic setting of a large-loop EM survey over a mineral deposit.