

An efficient 2D CSEM inversion algorithm employing a space-domain forward and gradient computation

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SUMMARY

We present an efficient two-dimensional inversion algorithm for controlled-source electromagnetic data. The algorithm employs a space-domain approach for forward modeling and gradient calculation. It utilizes boundary conditions on the plane that is perpendicular to the strike direction and passes through the source position to optimize the number of grids required for the discretization of the model. The boundary conditions for different source types depend on whether the electric and magnetic fields are symmetric or antisymmetric. Based on our benchmarking analysis, we found that around eight grids are sufficient to accurately discretize space in the strike directions for forward response and gradient computations. The inexact Gauss-Newton optimization technique is applied for inverse modeling where the regularized linear system of equations is solved using a conjugate gradient solver. Numerical experiments using synthetic and real-field data are tested to demonstrate the robustness and versatility of the developed algorithm. Inversion experiments also agree with the forward response benchmarking analysis that a small number of grids (approximately eight) are sufficient to discretize space in the strike direction. For all the experiments, the proposed algorithm exhibits at least one order computation time efficiency and 1.5 to 2.5 less memory requirement compared to a wavenumber domain code. Another salient feature of the developed algorithm is that it is easy to implement.