

# Application of the adjoint state method in the magnetotelluric inversion

\*Atsushi Suzuki<sup>1</sup>

1. JX NIPPON EXPLORATION AND DEVELOPMENT CO.,LTD.

The magnetotelluric method is a commonly used method to survey subsurface structures. Recently, three-dimensional magnetotelluric inversion has been a popular way. However, the cost of the inversion is high because it requires to solve large scale discretized PDE and iterative calculations. Especially, to update model parameters, we need the calculation of the gradient or Jacobian with respect to model parameters in the objective function, which takes much time and computing resources. The Adjoint State Method is an effective way to calculate the gradient of the objective function. In this method, the main cost is solving an additional adjoint equation. This is the same scale equation as the forward problem. It means that we can obtain the gradient at an additional solve of linear equation which is the same size of original discretized PDE. This is more effective than the conventional method (Johnson, 2021). Furthermore, the adjoint equation can be solved using the result of decomposition of the original discretized PDE.

Using this method, we developed a code to solve three-dimensional magnetotelluric inversion problem. We also tested whether we can inverse the true resistivity structure using the synthetic data which is obtained from a forward calculation of the model like Wannamaker(1991). As a result, we can obtain the similar resistivity structure in Wannamaker(1991).

Keywords: magnetotelluric , Inversion, Adjoint State Method, exploration Geophysics