

# Global Optimization Inversion of Horizontal Electric Dipole Time-Domain Electromagnetic Data Using Particle Swarm Optimization

Cahyo Aji Hapsoro<sup>a,\*</sup>, Wahyu Srigutomo<sup>b</sup>, Eleonora Agustine<sup>c</sup>

<sup>a</sup>Astronomy and Geophysics Research Group, Physics Department, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Jl. Semarang 5 Malang 65145, Indonesia

<sup>b</sup>Physics of Earth and Complex System, Physics Department, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung, Jl. Ganesa 10 Bandung 40132, Indonesia

<sup>c</sup>Geophysics Department, Faculty of Mathematics and Natural Sciences, Padjadjaran University, Jl. Raya Sumedang 45363, Indonesia

\*Corresponding author, e-mail address: cahyoajihapsoro@gmail.com

## Abstract.

We implement the global optimization of horizontal electric dipole – time domain electromagnetic (HED-TDEM) data through the application of particle swarm optimization (PSO) algorithm. This probabilistic approach is alternative to the widely used deterministic - local optimization approaches. In PSO algorithm, each particle that constitutes the swarm epitomizes a probable geophysical model comprised by subsurface resistivity values at several layers and thickness of each layer. The forward formulation of the TDEM problem for calculating the vertical component of the induced magnetic field is expressed first in Laplace domain. Transformation of the magnetic field from Laplace domain into time domain is performed by applying the Gaver-Stehfest numerical method.

The implementation of PSO inversion to the TDEM problem is straightforward. It only requires adjustment of few inversion parameters such as inertia, acceleration coefficients and numbers of iteration and particles. The PSO inversion scheme was tested to synthetic noise-free data and noisy data, as well as to field data recorded in a volcanic-geothermal area. The results suggest that the PSO inversion scheme can efficaciously solved the HED-TDEM 1D stratified earth problem.

**Keywords:** time-domain electromagnetic, horizontal electric dipole, particle swarm optimization, resistivity