



The novel high-performance 3-D MT inverse solver

Mikhail Kruglyakov (1,2), Alexey Geraskin (2), and Alexey Kuvshinov (2)

(1) Lomonosov Moscow State University, Moscow, Russian Federation (m.kruglyakov@gmail.com), (2) Institute of Geophysics, ETH Zurich, Zurich, Switzerland

We present novel, robust, scalable, and fast 3-D magnetotelluric (MT) inverse solver. The solver is written in multi-language paradigm to make it as efficient, readable and maintainable as possible. Separation of concerns and single responsibility concepts go through implementation of the solver. As a forward modelling engine a modern scalable solver *extrEMe*, based on contracting integral equation approach, is used. Iterative gradient-type (quasi-Newton) optimization scheme is invoked to search for (regularized) inverse problem solution, and adjoint source approach is used to calculate efficiently the gradient of the misfit.

The inverse solver is able to deal with highly detailed and contrasting models, allows for working (separately or jointly) with any type of MT responses, and supports massive parallelization. Moreover, different parallelization strategies implemented in the code allow optimal usage of available computational resources for a given problem statement. To parameterize an inverse domain the so-called mask parameterization is implemented, which means that one can merge any subset of forward modelling cells in order to account for (usually) irregular distribution of observation sites. We report results of 3-D numerical experiments aimed at analysing the robustness, performance and scalability of the code. In particular, our computational experiments carried out at different platforms ranging from modern laptops to HPC Piz Daint (6th supercomputer in the world) demonstrate practically linear scalability of the code up to thousands of nodes.