Metal-bearing infrastructure as passive secondary source in controlled-source electromagnetic investigations

H. Treppke[1], M. Becken[2] and R. Rochlitz[3]
[1]University of Münster, Institute of Geophysics, htreppke@uni-muenster.de
[2]University of Münster, Institute of Geophysics, michael.becken@uni-muenster.de
[3]Leibniz Institute for Applied Geophysics, Hannover, raphael.rochlitz@leibnitz-liag.de

SUMMARY

As the demand for geophysical exploration of domestic resources within inhabited areas increases, so does the need to understand and reduce the impact of anthropogenic noise sources. We focus on electromagnetic (EM) data that can be strongly afflicted with the impact of metal-bearing infrastructure. State-of-the art EM techniques deal with distorted electromagnetic measurements and artefacts in derived conductivity distributions by exclusion of affected data, unavoidably resulting in decreased spatial resolution.

Infrastructure objects such as power lines, conveyor belts, railway tracks or steel-casings of pipelines are typically very conductive and exhibit high material property contrasts to the surrounding while being particularly small-scale in geometry. Physically and numerically, such objects are interesting yet challenging to study: While electromagnetic coupling to the surrounding conductive Earth is complex, accurate modelling of infrastructure effects is highly computationally expensive. Rather than dealing with the effects of infrastructure that is itself actively current-carrying, such as the corrosion protection of pipelines, we are addressing the induced currents in metal-bearing infrastructure caused by an active EM source in semi-airborne electromagnetic (sAEM) investigations.

Based on an established procedure for modelling of strong material property contrasts, highly conductive objects can be treated as 1D perfect electric conductors (PECs), implying corresponding boundary conditions on mesh element edges. We exploit the potential and limits of this approach for sAEM data in 3D inversion and expand on this by developing an approach to treat metal-bearing infrastructure as secondary source - comparable to transmitters used in sAEM. On simplified synthetic and field data examples, we demonstrate that inversion for the actual current in infrastructure segments, subsequent modelling of arising secondary field contributions and correction for this secondary source impact successfully attenuates infrastructure effects. In an ongoing effort, we extend this idea to larger and more representative data sets from recent sAEM surveys.

Keywords: semi-airborne electromagnetics, electromagnetic coupling