EFFECT OF CURRENT ELECTRODE POSITIONS AND OF GAUSSIAN NOISE ON TENSORIAL INVARIANTS

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On basis of magnetotelluric invariant studies, from an old (the so-called “potential gradient mapping”) method (described in details by Varga et al., 2008) we developed a tensorial DC electrical resistivity mapping technique. The well known tensorial form of the differential Ohm’s law provides a 2×2 resistivity tensor, which relates the horizontal current density vector and the corresponding electric field vector. In the DC apparent resistivity tensor there are three independent rotational invariants, so an arbitrary 1D, an arbitrary 2D and an arbitrary 3D indicator (plus the measuring direction) completely determine the resistivity tensor. Over a 3D numerical model, any 1D invariant-indicator (det, ssq, trace, WAL I1) proved to be equally useful, but the multidimensional (2D: WAL-I2 and 3D: WAL-I3) invariants were informative only in case of very significant subsurface inhomogeneities. Moreover, the multidimensional indicators were very much influenced by the Gaussian noise. (We added a 3 % noise to the model response.) In a field study, carried out in an archaeological site over a buried wall remnant, we investigated the effect of various current electrode positions to all these invariant parameters. Ten different electrode position systems (asymmetric, diagonal, offset, rotated, elongated, shortened, etc.) were realized. Each 1D invariant provided good image about the subsurface structure; the 2D invariant proved to be partly useful, while the 3D invariant was completely useless. These results might be instructive, even somewhat warning for magnetotellurics. Acknowledgement: Hungarian Scientific Research Fund, NI 61013.

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