Geophysical Research Abstracts, Vol. 7, 01661, 2005
SRef-ID: 1607-7962/gra/EGU05-A-01661

Equivalence of rotational invariant- and tensor decomposition approaches in magnetotellurics

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The number of nonzero real-valued elements in the magnetotelluric impedance tensor (the starting point to any further interpretation) is given by the expression 2D, where D is the dimensionality number (1, 2, or 3). In order to exploit all information contain in the tensor, as many independent interpretation parameters should be considered, as many is the number of nonzero tensor elements (e.g. 8 in D=3). Under the name “tensor decomposition”, a lot of efforts have been devoted to remove effects of various near-surface inhomogeneities that distort or mask anomalies of deep structures. For a 3D tensor they offer up to 9 parameters at the output, but one scalar factor cannot be separated from the impedance elements. Another - much more systematic - trend, becoming more and more important, is to transform the impedance tensor into rotational invariants. The seven independent rotational invariants (together with the original direction) provide altogether 8 parameters, thus - as shown by a companion paper (Novák and Szarka 2005) - a system of invariants gives a mathematically equal representation of the original tensor. While the rotational invariant transformation produces 7+1 parameters, the tensor decomposition approaches provide 9-1 ones. Since 7+1=9-1, it is not surprising that the results by using these two approaches should give in principle the same results. For visualization of the full tensor, a proper system of its invariants are recommended. Acknowledgement: Hungarian Research Foundation T37694.