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Eigenvalue method in the geomagnetic inverse problems: an application to the time-averaged field model

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In the geomagnetic inverse problems derived from the paleodirection dataset excluding the abosolute intensity data, we have to pay attention to the impossiblity of the determination of the absolute Gauss coefficients, since the direction data have nonlinear relation to the coefficients and do not have quantitative information of the field at all. Thus, the relative Gauss coefficients to the fixed geocentric axial dipole term, g10, were determined in most of the geomagnetic inversion studies. This normalization method is effective in the problems of the geomagnetic field not in reversal transitions and excursions, and the time-averaged field analysis.

However, Mochizuki (1994) indicated that in this normalization method the determined solutions depend on the normalization coefficients. For instance, in the case that the normalization is done by the g10 term, the distortion of the solution is significant as the field becomes distant from the g10 field.

On the other hand, Mochizuki (1994) proposed the 'Eigenvalue Method' in order to avoid this effect, in which the problem reach an linear eigenvalue problem with using the linearization of the direction data (Benkova et al, 1970; Creer et al., 1973) and normalization of the model vector norm. However, he demonstrated only a simple, synthetic illustration in the basic least-square method.

In this study, we show a formulation of the eigenvalue method in the stochastic inversion (Gubbins, 1983) and an application to the realistic data, the time-averaged field for the last file million years. The result of the eigenvalue method shows a field model which is very close to the result of the nonlinear inverse method (Hatakeyama and Kono, 2002). We will apply this method in the case of the inverse problem of the reversal transitions field and excursions after the accumulation of the these datasets.