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The 3D magnetic imaging using the L1 regularization and variable selection procedure.

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Recently some new method to obtain 3D subsurface structure from the gravity or geomagnetic data were proposed. Some of them have a goal to obtain a stable and most simple model which reproduce the observed data in high accuracy. This is because, in generally, most of the traditional way of inversion for the potential data provides distorted or unfocused mages of real gravitational or magnetic structures. In this study, we propose a new method introducing a L-1 penalized least square procedure and tried to obtain a simple, and therefor high- resolution model.

Lasso(Tibshirani,1995) is a linear regression and variable selection procedure based on the L1 penalized least square. L1 penalty has a effect of shrinkage the value of regression coefficients which has only weak contributions to be 0. So, the Lasso does both continuous shrinkage and automatic variable selection simultaneously. On the other hand, Lasso has some limitations and restrictions. One of them is, at most Lasso algorithm can select nonzero variables of same number of observed data. So, in the case of p <<n problem, i.e. in the case of number of unknown regression coefficients (p) is larger than the number of observations(n), this algorithm cannot be adopted or overly shrinkage model will be obtained.To overcome this limitation, Zou and Hastie (2005) proposed a new L-1 penalized method named Elastic Net.This method is a compromise of the L-1 and L-2 regularization method with two control parameters. Using this method, we can treat p <<n problems in the framework of L-1 penalized method.

In our presentation, we will show the results of applying this method to the synthesized and real magnetic data.

Keywords: potential, geomagnetism, magnetic structure, L-1 norm regularization