The sparse inversion of the magnetic data to recover subsurface blocky structures.

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Magnetic inversion is one of the popular method to obtain information about the subsurface structure. However, this method has a serious problem, that is, the linear equations to be solved become ill-posed, under-determined, and thus, the uniqueness of the solution is not guaranteed. As a result, several different models fit the observed magnetic data with the same accuracy. To reduce the non-uniqueness of the model, conventional studies introduced regularization method based on the quadratic solution norm. However, these regularization methods impose a certain level of smoothness, and as the result, the resultant model is likely to be blurred.

To obtain a focused magnetic model, Utsugi (2019) introduced a combination of the conventional L2 norm penalty (which is equivalent to the first order Tihkonov penalty) and L1 norm penalty. As is widely known, L1 norm regularization promotes sparseness of the model. Utsugi (2019) showed that, by introducing the L1-L2 norm penalty into the magnetic inversion, a model which is not overly blurred, and not excessively concentrated can be derived.

To facilitate the model interpretation, some of recent inversion studies focused on to recover the sharp boundary and block structure. However, L2 norm penalty is very simple and favorable because of its convexity, the ability to recover the sharp boundaries seems to be not enough when it is used with L1 norm penalty. Therefore, in this study, I tried some variations of the penalties which is used as the combination with the L1 norm penalty, such as fused-lasso penalty (Tibshirani, 2005), TSV (Total Squared Variation) penalty (Kuramochi et al.,2018), and will discuss about the best combination of the penalty which has good ability to recover the blocky structure, and is easy to implement.

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