

Comparison of the robust estimator with the least square estimator in magnetotelluric impedance estimation

The magnetotelluric(MT) method has been proved to be an effective geophysical method to image subsurface electrical conductivity. Due to the unknown source, the time-varying MT data are Fourier transformed to estimate the MT impedance tensor, which is further interpreted to obtain the subsurface structure. Thus, the impedance estimation is considered an important step for MT exploration. The MT impedance estimation problem is similar to the linear regression problem in the statistic. The least square estimator which is derived from maximum likelihood estimation based on Gaussian noise assumption is a common way that is applied in the linear regression problem. Another more effective way in parameter estimation is the robust estimator which can reduce the effect of the outliers. In this term project, I will compare these two estimators in both synthetic MT data and measured MT data. In synthetic MT data, I will add different distributed man-made noise (e.g. Gaussian, Cauchy, and Levy noise) to the electric data and compare the results from two estimators. I will also apply these two estimators in some measured MT data that are collected in Tibet Plateau. In synthetic data tests, the results show that with Gaussian noise these two methods perform similarly. With the extreme noise, the robust method is much better than the least square method. However, if some noise exists in the input channel (magnetic field), both methods fail and I adapt a remote reference method to reduce the effect of noise in the input channel. When these two estimators are applied in real measured MT data, in some measured MT data, these two estimators perform very similarly. In some heavy polluted MT data, the robust estimator performs better than the least square estimator. The conclusion is that the robust estimator can be more practical than the least square estimator. However, when the input channel has some noise, some additional steps should be adapted to reduce the outliers in the input channel.