Sparse Representation De-noising for MT Signal Combined with Particle Swarm Optimization

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The magnetotelluric (MT) method is one of the most mainstream means in deep mineral resource exploration. MT signals are extremely vulnerable to noise since they employ natural electromagnetic fields as a source. The existing methods are often ineffective for strong cultural noise, especially the charge-discharge-like noise. To this end, we propose a new noise attenuation method for MT signal based on sparse representation and Matching Pursuit (MP) algorithm. A redundant dictionary which is insensitive to useful MT signal was developed for the representation of charge-discharge-like noise. Particle Swarm Optimization (PSO) is used to find the best atoms from the dictionary. Simulated experiments and real MT data were used to test the proposed scheme. As a conclusion, not only can charge-discharge-like noise be effectively removed, spikes and some other irregular noise can also be well suppressed. The apparent resistivity and phase curves obtained after applying our scheme are greatly improved over previous methods. It addresses the problem that current methods can hardly deal with charging-discharging-like noise to some extent, so that the MT method can be applied in harsh environments.