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Application of Compressed sensing for inversion of Electrical Resistivity Tomography

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Image reconstruction algorithms derived from electrical resistivity tomography (ERT) are often suffer from sparse, ill-posed condition. This problem is aggregated when the number of measurements are further decreased due to elimination of bad data (noise), which is typical case in hard-rock aquifers. Conventional gradient based inversion techniques with L2 norm minimization through smoothness constraint regularization can result in a stable solution to such under determined problems. However, regularization applied to the objective function may lead to a solution with no edge sharpness in image artifacts. Compressive sensing (CS) takes an advantage of reconstructing sparse signals from a relatively small data sets. If favorable conditions are met, CS was proven to be an efficient technique for image reconstruction using limited data points without losing edge sharpness. A generalized MATLAB code for 3D static ERT inversion using CS is presented in this work. The forward modelling code was adopted from an existing open source MATLAB code 'RESINVM3D' and a static 3D ERT inversion code using CS algorithms was developed. Two CS algorithms with L0 and L1 regularizations were applied to a synthetic layered model with surface electrode measurements. The algorithms were compared in terms of quality of reconstructed image of computational cost by gradually decreasing the observed data space. In comparison to conventional gradient based algorithms, CS has proven to develop the 3D resistivity structure with minimal artifacts and less number of measurements