On a nonlinear inverse problems in electromagnetic sounding

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Electromagnetic induction measurements are often used for non-destructive investigation of certain soil properties, which are affected by the electromagnetic features of the subsurface layers. Knowing such parameters allows one to identify inhomogeneities in the ground, and to ascertain the presence and the spatial position of particular conductive substances, such as metals, liquid pollutants, or saline water. A linear and a nonlinear models are generally used to describe the interaction of an electromagnetic field with the soil, but if the conductivity of some subsurface layer is large only the nonlinear model is reliable.

Starting from electromagnetic data collected by a ground conductivity meter, we propose a regularized inversion method based on a low-rank approximation of the Jacobian of the nonlinear model. The method depends upon a relaxation parameter, which ensures the convergence to a positive solution, and a regularization parameter. Both parameters are chosen by automatic procedures. This leads to a fast and reliable algorithm. The performance of the method is investigated by numerical experiments on both synthetic and experimental data sets.