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Joint inversion of crosshole tomographic data using the cross-gradient criterion

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Combinations of crosshole tomographic techniques (e.g., GPR, ERT, seismic) are commonly used in hydrogeological site-characterization. Inversions of different data types are often carried out individually and, at a later stage, combined with other geophysical models and available hydrogeological data, in order to create a hydrogeological model. We adopt the cross-gradient criterion, originally developed by Gallardo and Meju (2003) for joint inversion of surface based dc resistivity and refraction seismic data, to invert crosshole tomographic data. Joint inversion makes the resulting inverse problem less ill-posed compared with the individual inversions, hopefully making the resultant model more consistent with the hydrogeological units between the wells. By using the cross-gradient criterion we avoid parameterization of the petrophysical relationships and the underlying relationships can therefore be unknown, non-linear, and non-stationary. Synthetic examples are used to validate our methodology and its implementation. We present joint inversion models of GPR and ERT data for real sites and evaluate the improvements compared with the individual inversion models.

Reference:

Gallardo, L.A., and M.A. Meju, Characterization of heterogeneous near-surface materials by joint 2D inversion of dc resistivity and seismic data, *Geophys. Res. Lett.*, 1658, doi.:10.1029/2003GL017370, 2003.