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Time-lapse optimised survey design for geoelectrical resistivity monitoring

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Optimised measurement arrays for resistivity surveys have been shown to provide superior image resolution with no increase in survey time or power when compared to standard array configurations. When applied to monitoring studies, sequential optimisation methods have the potential to increase the resolution further by using previous data and results to guide the design of subsequent surveys. This study describes the application of a sequential design technique to produce optimised time-lapse geoelectrical surveys, which focus a greater degree of the image resolution on regions of the subsurface that are actively changing, compared to conventional optimisation techniques which provide static optimised surveys only.

The sequential design method is applied to a synthetic 2.5D monitoring experiment comprising a well-defined cylindrical target moving along a trajectory that changes its depth and lateral position. The data are simulated to be as realistic as possible, incorporating survey design constraints for a real resistivity monitoring system and realistic levels and distributions of random noise, in order to match a forthcoming experimental test of the method. The results of the simulations indicate that sequentially optimised time-lapse surveys produce an increase in image quality compared to the results of a static (time-independent) optimised survey.