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## Towards improved Characterisation of fractured Rock for hydrological Applications: an Introduction to non-linear Seismic Slowness Inversion using Simulated Annealing

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A non-linear inversion scheme based on simulated annealing has been developed to characterise seismic slowness distributions typical of those found in fractured aquifer rock. The forward model considers ray-bending according to Snell's law. Using synthetic models to generate travel-times and including noise of varying magnitudes, inversions of the synthetic data show that this new method is robust in finding the optimum solution to the inverse problem. The major benefits of this non-linear approach are that (i) the method will find the global optimum regardless of the starting model – final result misfit; (ii) the scheme shows robust insensitivity to noise, thereby improving reliability in the light of typically low signal to noise ratios characterising first break picks from near-surface seismic data. Future developments will focus in particular on characterisation of flow heterogeneity in near-surface fractured rock through introduction of seismic anisotropy parameters into the new non-linear inversion framework, and application to VSP data collected in major UK aquifer rocks.