Geophysical Research Abstracts
Vol. 21, EGU2019-17682, 2019
EGU General Assembly 2019

Probabilistic Travel Time Tomography using Neural Networks

Stephanie Earp and Andrew Curtis
University of Edinburgh, United Kingdom

Seismic travel time tomography is a nonlinear inverse problem commonly used to investigate the internal structure of the Earth at all scales. Monte Carlo methods are often used in inversion schemes to provide probabilistic solutions. However, such sampling methods are computationally expensive. Neural networks provide an efficient way to obtain probabilistic solutions to highly non-linear problems. We use an Eikonal raytracer to forward model many synthetic source receiver travel-time pairs from uniformly random velocity models to create a training dataset which encapsulates our Bayesian prior probability distribution. Neural networks and convolutional mixture density networks are trained to invert for velocity models and their (fully nonlinear) uncertainties from source receiver travel-time pairs. The networks produce fully probabilistic solutions in the form of weighted sums of multivariate Gaussians which approximate the Bayesian posterior probability distribution. The networks can be applied to new data, not used in training, to provide almost instantaneous inversion results. We show that the neural network results are comparable to those from traditional Monte Carlo sampling methods. However, unlike Monte Carlo inversion methods, once a network is trained it gives far faster inversion results.