Geophysical Research Abstracts
Vol. 13, EGU2011-1042, 2011
EGU General Assembly 2011

Application of Artificial Neural Networks to Seismic Tomography

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The seismic tomography can be used to constrain estimates of the Earth's velocity structure. This kind of problem is usually known to be non-linear, high-dimensional, with a complex search space which may be riddled with many local minima, and results in irregular objective functions. We investigate here the performance and the application of a radial basis function artificial neural network (RBF-ANN) type, in the tomographic velocity reconstruction. The proposed structure has the advantage of being easily trained by means of a back-propagation algorithm without getting stuck in local minima. The effects of network architectures, i.e. the number of neurons in the hidden layer, on the rate of convergence and prediction accuracy of ANN models are examined. The optimum network parameters and performance were decided as a function of the testing error convergence with respect to the network training error. An adequate cross-validation test is run to ensure the performance of the network on new data sets. The application of such a network, to synthetic shows that the inverted seismic velocity section was efficient. A comparative reconstruction with two classical methods was performed using Algebraic Reconstruction Technique (ART) and Conjugate Gradient (CG). The results clearly show improvements of the quality of the reconstruction obtained by radial basis function artificial neural network.

Keywords: radial basis function, training, Back-propagation, traveltime, velocity, tomography, backprojection, Conjugate Gradient