Neural Network and Neuro-Fuzzy in Modeling of Highly Non-Linear Geophysical Well Logs Data-A Comparison

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Modelling of layer formation of the earth dynamics is one of the most studied topics in geophysical well logging due to its essential application to map the subsurface structures of the earth dynamics. Recently, artificial intelligence has gained much popularity for calibrating the nonlinear relationships inherent in the geophysical field. In this study, the advantages of artificial neural networks and neuro-fuzzy system in modelling of the layer formations were examined. Two different adaptive techniques namely Levenberg–Marquardt feed forward neural network (FFNN) and neuro-fuzzy were constructed and examined to constrain the lithofacies boundaries by three sets of well log data such as density, resistivity and gamma ray that obtained from the German Continental Deep Drilling Project, (KTB). In addition, the effects of data transformation on model performance were also investigated. This was done by examining the performance of two network architectures and training algorithms using both field raw and normalised transformed data. Through inspection of the results, it was found that although the model built on transformed data outperforms the model built on raw data, no significant differences were found between the predicted accuracies of the two examined models. A detailed comparison of the overall performance indicated that the neuro-fuzzy model performed better than the Levenberg–Marquardt-FFNN. This neuro-fuzzy technique allows users to process the well logging data, to train/test the model using various input options and to visualize results. Comparisons the obtained results with geological/geophysical evidences suggest that the developed technique resolves the kind of gneisses embedded at certain depths and renders a robust for the classification of complex litho-facies successions of the study area. This technique also resolves a significant finer structure such as one kind of Amphibolite successfully. Thus this may provide useful information for understanding the inhomogeneity crustal structure in other regions.

Keywords: Neural networks; Neuro-fuzzy; Rock boundary detection, KTB