Artificial Intelligence Approach to Predicting Local Crust Movement Using GNSS Continuous Operating Reference Systems Data

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SUMMARY

The frequent occurrence of disasters worldwide has incited the need for rigorous experimentation with advanced techniques that would help mitigate risk, as these disasters result in countless loss of lives and properties, thus, increasing the economic expenditure of nations. Therefore the forecasting of a precise crustal movement is of great significant, not only to the geoscience community but the world at large. One way to understand crustal movement geodetically, is by using Geodetic Point Velocity (GPV). The object of this research is to analyze the predictive capability of four Artificial Neural Network (ANN) models in predicting GPV in Ghana. Based on the observations of the eight (8) GNSS CORS in the southern part of Ghana, the velocity data derived was divided into two; 80% for training and 20% for testing and validation. First, the Backpropagation Neural Network (BPNN) model was developed with three (3) inputs, i.e. Vx, Vy and Vz, 50 hidden layers with their synaptic weights and 1 output layer. Afterwards, the remaining three models, GRNN, RBFNN and GMDH were trained and tested with the same data. Geocentric coordinates Xm, Ym and Zm with their respective Geodetic Point Velocities were used as inputs (Vx, Vy, Vz) for the BPNN, RBFNN, GRNN and GMDH models. The performances of all the models were assessed using root mean square error (RMSE), mean absolute error (MAE), and coefficient of determination (R2). Based on the results obtained, it was found out that three (3) out of the four (4) proposed AI techniques was able to produce sound GPV predictions. However, the GMDH was proposed to be suitable as it was able to predict the GPV precisely. This was selected based on the statistical approach for the evaluation of the prediction of the models. For instance, the other models (BPNN, RBFNN and GRNN) could produce comparable results as their R2 values were marginally different from that of the GMDH model which ranges between the ranges of 0.002 to 0.298.
