Towards Improved Geodetic Modelling: Prediction of Gravity Values Using Artificial Neural Networks in Akure, Nigeria

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Key words: GNSS/GPS; Positioning; Reference frames; Reference systems; Gravity Prediction; Artificial Neural Networks; Geodesy

SUMMARY

Accurate gravity prediction is fundamental in geodesy, geophysics, and Earth science applications such as geoid modelling, mineral exploration, and environmental monitoring. Traditional interpolation techniques often fail to capture the complex nonlinear relationships in gravity data, particularly in areas with sparse measurements. This study develops a multi-layered Artificial Neural Network (ANN) for predicting terrestrial gravity values in the Akure environment of southwest Nigeria. Geodetic positions (latitude, longitude, ellipsoidal height) were determined at 59 GNSS-observed stations, while gravity values were measured with a Lacoste and Romberg (G-512 series) gravimeter. Standard corrections—including drift, tidal, free-air, and Bouguer—were applied to ensure accuracy. The ANN architecture, comprising 40 hidden neurons, was trained and tested using MATLAB. Model performance was evaluated with RMSE, MAE, and R^2. Results indicate that the ANN model predicted gravity values with high accuracy (RMSE = 0.0000286 mGal, MAE = 0.0000220 mGal, R^2 = 0.63), demonstrating its capability to model nonlinear relationships between geodetic coordinates and gravity. The predicted values closely matched observed field measurements, validating the effectiveness of the approach. This research underscores the potential of machine learning in modern geodesy, offering a robust alternative to conventional gravity prediction methods. The methodology supports applications in geodetic infrastructure, natural resource management, and environmental studies, aligning with FIG's mission to advance surveying and geospatial sciences for societal development.

Keywords: Gravity Prediction, Artificial Neural Network, Geodesy, GNSS, Nigeria

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