Depth estimation of gravity anomalies using Artificial Neural Networks

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Abstract:

The method of Artificial Neural Networks is used as a suitable tool for intelligent interpretation of gravity data in exploration; in this paper, we have designed a Hopfield Neural Network to estimate the gravity source depth. To calculate the weights and biasing values of the network first the network is designed for the models near to sphere or cylinder and these weights are fixed and the network will rotate so that finally get to its stable state . In this state the energy of the network will be in its minimum value. Thus the network will run for some different initial values of depths and the one which will have the least final energy will finally the depth of gravity source. It is very important to test the designed network we fed the noisy data to it and observed its behavior.

This Artificial Neural network was used to estimate the depth of a qanat in north entrance of the Geophysics Institute of Tehran University and the result was very near to the real value of depth.

Keywords: Artificial neural network, Gravity Exploration, Depth estimation,Hopefield

1-Introduction:

Neural Networks are increasingly being used in prediction, estimation, and optimization problems. Neural networks have gained in popularity in geophysics this last decade.

They have been applied successfully to a variety of problems in geophysics. Nowadays Neural Networks can be applied in microchip technology for computer hardware.

Recent developments in gravity measurements and especially in microgravity tools has been prepaid an excellent conditions of data acquisition to have better interpretation results specially depth estimation of gravity sources.

These developments, combined with higher speed data acquisition technology, have made it possible to detect much smaller objects like small cavities, chromites lenses, etc.

The gravity data sets are naturally noisy so that it is very hard to estimate the gravity source depths precisely. Therefore, there is an increasingly need for a fully automatic interpretation technique that can be used to make decisions regarding the nature of the sources in real time. The massively parallel processing advantage of Artificial Neural Networks makes them suitable for hardware implementation; therefore, the detection of small gravity sources objects will be possible more precisely.

However, gravity and specially microgravity data measurements create a large amount of data which needs to some corrections and filtering like: tidal correction, drift correction, latitude correction ,free air correction ,up-ward or down-ward continuation , etc that need to be analyzed and interpreted and this can be time consuming and results mostly have not good adaptations to real values .Therefore there is an increasing need for intelligent interpretation techniques that can be used to make rapid decisions in the field during operations .Specially its very important to mention that some techniques like Euler method ,Analytical signal ,up-ward continuation and

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