Evaluation of the Back Propagation Neural Network for Gravity Mapping

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Abstract – *Gravity map production has been improved by using very complicated and expensive versions of geophysics methods [1].*

The main objective of this study is to evaluate the ability of the Artificial Intelligent Techniques product gravity map.

To achieve the objective of this study Artificial Neural Network architecture has been tested. This is the BPN. The BPN model was trained with 646 patterns derived from gravity map and satellite image. The maps were converting to ASCII to generate the input part of the learning patterns. The same rows were used to generate the output part. A performance test session was carried out by applying the trained models to the same training patterns and to 162 new test patterns.

Key Words : AI: Artificial Intelligent, ANN: Artificial Neural Networks, ASCII: American Standard Code for Information Interchange, BPN: Back Propagation Neural Networks, GRACE: Gravity Recovery and Climate Experiment.

1. INTRODUCTION

Gravity is a potential field, i.e., it is a force that acts at a distance. The gravity method is a non-destructive geophysical technique that measures differences in the earth's gravitational field at specific locations. It has found numerous applications in engineering, environmental and geothermal studies including locating voids, faults, buried stream valleys, water table levels and geothermal heat sources. The success of the gravity method depends on the different earth materials having different bulk densities (mass) that produce variations in the measured gravitational field. These variations can then be interpreted by a variety of analytical and computers methods to determine the depth, geometry and density that causes the gravity field variations.

The conventional gravity map is sufficient very costly and not satisfactory enough satisfy the criteria of the research. While the gravity map presents a very rich indicator in oil exploration, to overcome and solve this problem. The research presents a satellite image for the same area, and by using artificial intelligent techniques [1, 2, 3].

The main objective of this study is to investigate the ability of artificial neural networks to product gravity map. This will be achieved by training and testing an appropriate ANN architecture with learning patterns generated from satellite image and corresponding accurate values derived from a satellite image.

To improve the opportunity to find oil, geologists apply earth science to the search for oil. Many techniques have been developed, based on indirect methods to view the subsurface. Among the most important are:

Seismology, which is the study of the sound waves that bounce off buried rock layers. It involves seismic surveys that are analyzed by knowledgeable personnel [4].

Geological Mapping, which is used by geologist to define possible reservoir shapes or traps, due to the deformation in the rock layer that contains hydrocarbons [5].

Educated guesses, which use physical geology and seismic information as the base material to guess where to drill [6].

To solve this problem:-

a) High spectral space images will be enhanced to highlight gravity issues.
b) An existing gravity map will be georeference to bring the whole test data into a common georeference.
c) Training and test patterns will be generated from the satellite image and the existing gravity map.
d) An ANN's system will be built, specified and trained for predicting gravity indicators (map) based on previous experience.

The performance of the trained model will be checked by applying it to a new set of test data

e) (patterns), whose actual outputs are already known.
f) The results will be analyzed, discussed and assessed.

2. STUDY AREA

The experimental test carried out in this study was based on test data collected and observed from satellite image of Khartoum City (Figure 1).
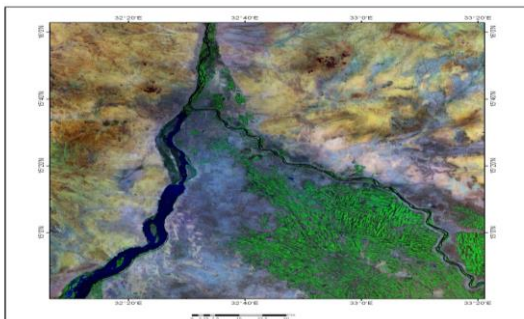

Figure 1: Satellite Image for Khartoum City.

The satellite image of Khartoum City (Figure 1) was acquired by the American IKONOS imagining system in 2005. The spatial resolution of this image is one meter, while the spectral resolution covers the visible (two bands) and the infrared (one band) spectrum regions. Table 1 lists the specifications of this image.

One of the most important set of the test data used also in this study is a gravity map of Khartoum City (Figure 2). Earth's gravity measured by NASA's GRACE mission, showing deviations from the theoretical gravity of an idealized smooth Earth, the so-called earth ellipsoid. Red shows the areas where gravity is stronger than the smooth,

standard value, and blue reveals areas where gravity is weaker.

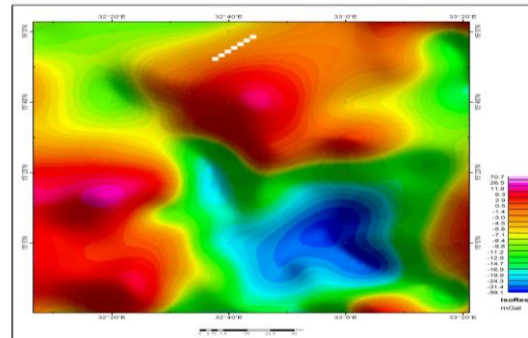Some data has been derived from gravity map as shown in figure 2.

Figure 2: Gravity map of Khartoum City.

3. PROCEDURES

A wide range of procedures were applied to meet the objectives of this study. The test was carried out in three phases. Phase one is concerned with image georeferencing, image slicing and production of ASCII images. In phase two a set of training and test patterns were generate to build an artificial neural network model to predict the gravity map of the test patterns based on the knowledge that was gained during the training session. In phase three the performance of the trained model.

4. RESULTS AND ANALYSIS

The BPN architecture was designed and trained with 5000 patterns as input patterns. The BPN takes more than 144 hours (Figure 3) and there was no improvement in the results or access to excellent readings, so experiment continued with other neural network model.
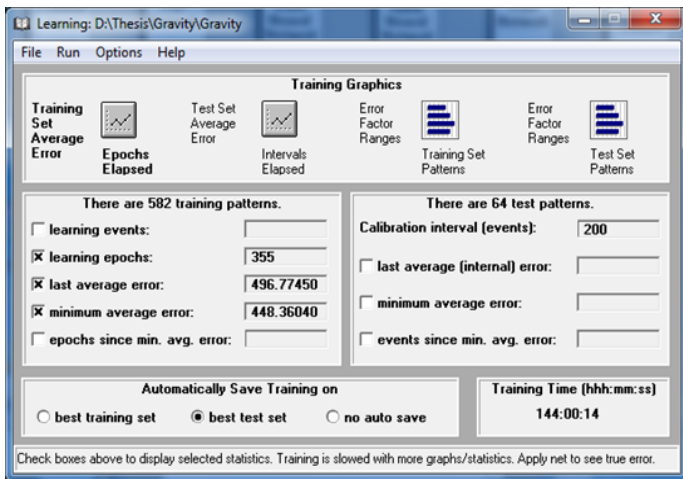
Figure 3: BPN Training.

5. CONCLUSION:

According to the training patterns that carried out in this study it can be concluded that the BPN model was not able to product gravity map. Therefore this model of ANN is not suitable in such applications.

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BIOGRAPHIES

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