EGU21-11472
https://doi.org/10.5194/egusphere-egu21-11472
EGU General Assembly 2021

Algorithms for constructing structural surfaces by geophysical data based on neural networks

Alexey Shklyaruk, Kirill Kuznetsov, David Arutyunyan, and Ivan Lygin
Lomonosov Moscow State University, Faculty of Geology, Moscow, Russian Federation (alexsh9898@gmail.com)

At the stage of small and medium-scale geological and geophysical studies, in addition to seismic exploration, methods of potential fields (gravimetry and magnetometry) are usually actively used. These methods, in contrast to the profile seismic observations, taking into account modern satellite and aviation technologies, provide a high-quality areal density and magnetic characteristics of the study area. The main tasks of modern gravimetry and magnetometry include the task of constructing areal models, contrasting in density and magnetization of surfaces. Among a large number of algorithmic solutions, the most effective are methods using an integrated approach, in which seismic data on the morphology of reflecting horizon is used as a reference.

Reconstruction of the structural surface morphology by geophysical data can be considered as the problem of finding the relationship between the input information (potential fields, geophysical data, and available a priori information) and the desired surface. To assess the dependence, it is proposed to use the reference plots on which both input and output data are presented. Currently, one of the trends in solving such problems is methods based on neural networks. Neural networks can be of various configurations (feedforward networks, radial-basis function networks, backpropagation networks, convolutional networks, etc.), have a different number of layers and neurons.

In this research, we consider the test and real-world example. A site with a known position of the sedimentary cover bottom is considered as a test model. To verify and compare the algorithms, the gravity and magnetic effects of the layer are calculated. The gravity and magnetic fields were supplied to the input to the algorithms for constructing regression dependence and training the neural network. An incomplete model of the sedimentary cover was supplied to the input for training neural networks. The task was to restore the missing part. The parameter of the standard deviation of the original and reconstructed model was less than 2% for all types of neural networks.

As a real model, a site was considered where basement cover is only partially available. It was obtained as a result of seismic interpretation. All available geological and geophysical data were used to reconstruct the horizon. Models obtained using reconstruction algorithms can be additional information for further detailed description of the geological structure.

It should be noted that since neural networks help to find complex functional relationships between field parameters and attributes of the studied environment, they could be used in the tasks of complex interpretation of geological and geophysical data.