Geophysical Research Abstracts
Vol. 12, EGU2010-6606, 2010
EGU General Assembly 2010

Forecast and restoration of geomagnetic activity indices by using the software-computational neural network complex

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It is known that currently used indices of geomagnetic activity to some extent reflect the physical processes occurring in the interaction of the perturbed solar wind with Earth's magnetosphere. Therefore, they are connected to each other and with the parameters of near-Earth space. The establishment of such nonlinear connections is interest. For such purposes when the physical problem is complex or has many parameters the technology of artificial neural networks is applied. Such approach for development of the automated forecast and restoration method of geomagnetic activity indices with the establishment of creative software-computational neural network complex is used. Each neural network experiments were carried out at this complex aims to search for a specific nonlinear relation between the analyzed indices and parameters.

At the core of the algorithm work program a complex scheme of the functioning of artificial neural networks (ANN) of different types is contained: back propagation Elman network, feed forward network, fuzzy logic network and Kohonen layer classification network. Tools of the main window of the complex (the application) the settings used by neural networks allow you to change: the number of hidden layers, the number of neurons in the layer, the input and target data, the number of cycles of training. Process and the quality of training the ANN is a dynamic plot of changing training error. Plot of comparison of network response with the test sequence is result of the network training. The last-trained neural network with established nonlinear connection for repeated numerical experiments can be run. At the same time additional training is not executed and the previously trained network as a filter input parameters get through and output parameters with the test event are compared.

At statement of the large number of different experiments provided the ability to run the program in a "batch" mode is stipulated. For this purpose the user a specially designed pre-list are created which perceived by software-computational neural network complex where each line the detailed description of each experiment is contained. In this case, it is possible to perform statistical studies of work ANN results.

The modular architecture of application with the purpose to solve various problems to modify it is allows. The developed software complex with sets of databases in the form of arrays, plug and downloaded separately is worked. For a complex functioning at present time the number of simultaneously processable streams of events in the input data has been determined.

Blocks of databases contain the numerical minute data for 30 geomagnetic storms during the period from 2000 to 2003: Solar wind parameter, an interplanetary magnetic field (from space craft "ACE") and geomagnetic indices (Dst, SYM, ASY, AU, AL). These data are received from http://cdaweb.gsfc.nasa.gov. Is it necessary, modified discrete data using the spline is provided.

This complex for wide range of tasks for the general trend studies of nonlinear connection between the different parameters determining the causal relationships in the system «interplanetary space-magnetosphere-ionosphere» is used. With this the following studies are carried out: the search of nonlinear connection of auroral and mid-current systems with the parameters of the solar wind and interplanetary magnetic field, the restoration of geomagnetic activity indices, the forecast and restoration of F2 ionosphere layer critical frequencies, the forecast maximum observed frequencies on the traces of oblique HF ionospheric sounding with perturbation

heliogeophysical parameters and others.

Work is executed at partial support under grants of the RFBR 08-05-12051-OBR and 09-05-00495, and also program Ministry of Education and Science «Development of higher school scientific potential (2009-2010, project N 1623)».