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Neural networks in the Baikal-GVD experiment: selection of neutrino events and neutrino energy reconstruction

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Baikal-GVD is a neutrino telescope with an effective volume of about 1 km^3 located in Lake Baikal. To enable observations within the framework of neutrino astronomy, the following event processing problems must be solved in the experiment:
1) selection of the neutrino (ν) component against the background of events, caused by extensive air showers (EAS);
2) reconstruction of the parameters of ν events, for example, the energy of the born muon.
In this paper we consider an approach to solving these problems using machine learning (neural networks). For problem 1) it is shown on Monte Carlo simulations of the data that at the level of background suppression of 10^6 times desired for the experiment using convolutional neural networks it is possible to preserve 50% of high-energy neutrino events. For problem 2, a neural network model is created that predicts both the energy itself and the expected error of this prediction for a given event. This is achieved by a loss function of a special kind. On Monte Carlo simulated data we achieve an error factor of 3 for a wide range of energies (from 10 GeV and above) and a factor of 2 for high energies (from 10 TeV and above), which corresponds to the accuracy of standard reconstruction methods. It is shown that the predicted energy error corresponds to one standard deviation of the real error.

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