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Machine learning in Baikal-GVD

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Baikal-GVD is a large-scale underwater neutrino telescope currently under construction in Lake Baikal. Its principal component is a three-dimensional array of optical modules (OMs) registering Cherenkov light associated with the neutrino-induced particles. The OMs are organized in clusters, each containing 8 vertical strings with 36 OMs per string.

Located in a natural water reservoir, the OMs are exposed to the luminescence of the Baikal water. This necessitates the search for highly effective algorithms for noise rejection as the first step of data analysis. We developed a convolutional neural network reaching ~97% signal purity (precision) and ~99% survival efficiency (recall) for the signal hits on Monte-Carlo data. The architecture of the neural network exploits the causal connection between individual hits, rather than their spatial location.

The other problem we are solving with the help of neural networks is a reliable identification of neutrino events. The underlying issue is that muons flux due to cosmic rays is many orders of magnitude higher than that of neutrinos. Hence the discriminating algorithm must have extremly small error rate. We discuss how this can be achieved by adjusting event weights and choosing a proper loss function for the neural network.

Type of Contribution

talk

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