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Machine learning aided noise filtration and signal classification of the CREDO smartphone data

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The wealth of smartphone data collected by the Cosmic Ray Extremely Distributed Observatory (CREDO) greatly surpasses the capabilities of manual analysis. So, efficient means of rejecting the non-cosmic-ray noise and identification of signals attributable to extensive air showers are necessary. To address these problems we discuss a Convolutional Neural Network-based method of artefact rejection and complementary method of particle identification based on common statistical classifiers as well as their ensemble extensions. These approaches are based on supervised learning, so we need to provide a representative subset of the CREDO dataset for training and validation. According to this approach over 2300 images were chosen and manually labeled by 5 judges. The images were split into spots, tracks, worms (collectively named signals) and artefacts classes. Then the preprocessing consisting of luminance summation of RGB channels (grayscaling) and background removal by adaptive thresholding was performed. For purposes of artefact rejection the binary CNN-based classifier was proposed which was able to distinguish between artefacts and signals. The classifier was fed with input data in the form of Daubechies wavelet transformed images.
In the case of cosmic ray signal classification, the well-known feature-based classifiers were considered. As feature descriptors, we used Zernike moments with additional feature related to total image luminance.
For the problem of artefact rejection, we obtained an accuracy of 98%. For the 4-class signal classification, the best performing classifiers achieved a recognition rate of 92%.

Keywords

machine learning; pattern recognition; large scale cosmic ray correlations; extensive air showers

Collaboration

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Subcategory

Experimental Methods & Instrumentation

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