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Particle identification in ground-based gamma-ray astronomy using convolutional neural networks

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Modern detectors of cosmic gamma rays are a special type of imaging telescopes (Cherenkov telescopes) supplied with cameras with relatively large number of photomultiplier-based pixels. For example, the camera of the TAIGA telescope has 560 pixels of hexagonal structure. Images in such cameras can be analyzed by various deep learning techniques to extract numerous physical and geometrical parameters and/or for incoming particle identification. We implement for this purpose the most powerful deep learning technique for image analysis, the so called convolutional neural networks (CNN).

In this work we present the results of tests with two open source machine learning libraries, PyTorch and TensorFlow, as possible platforms for particle identification in imaging Cherenkov telescopes. Monte Carlo simulation was performed to analyze images of gamma rays and other (background) particles as well as estimate identification accuracy. Further steps of implementation and improvement of this technique are discussed.

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