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Efficient Level 2 Trigger System Based on Artificial Neural Networks

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The HESS project is a major international experiment currently performed in gamma astronomy. This project relies on a system of four Cherenkov telescopes enabling the observation of cosmic gamma rays. The outstanding performance obtained so far in the HESS experiment has led the research labs involved in this project to improve the existing system: an additional telescope is currently being built and will soon take place within the previous telescope system. This telescope is designed to be more sensitive to the detection of low energy particles than the others, leading to an increase of the number of collected particle images. In this context which is tightly constrained in terms of latency, physicists have been compelled to design an additional L2 Trigger in order to deal with a huge amount of data. This trigger aims at selecting images of interest (ie. gamma particles) and rejecting all other events that are associated to noise. Contrary to classical methods that consist of strong cuts based on Hillas parameters, we propose an original approach based on artificial neural networks.

In this approach, collected events are first handled by a pre-processing level whose purpose consists in applying transformations on incoming images, thus reducing the dimensionality of the problem. It is based on Zernike moments computation that aims to extract the main features of the images and guarantee image invariance in translation and rotation. Zernike moments have also proved to be reliable in terms of their feature representation capability and low noise sensitivity.

In a second step, an artificial neural networks ensures the classification of events within two classes (gammas and hadrons), indicating whether to keep the image for future processing or to reject it.

In this presentation, we will describe the entire L2-Trigger system and provide some results in terms of classification performances. We will discuss the contribution of neural networks in this type of experiments compare to classical solutions.

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