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Ultra-fast generation of Air Shower Images for Imaging Air Cherenkov Telescopes with Generative Adversarial Networks

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The development of precise and computationally efficient simulations is a central challenge in modern physics. With the advent of deep learning, new methods are emerging from the field of generative models. Recent applications to the generation of calorimeter images showed promising results motivating the application in astroparticle physics. In this contribution, we introduce a deep-learning-based model for the fast generation of air shower images as measured by an Imaging Air Cherenkov Telescope (IACT). Our work relies on simulations of the CT5 telescope that is part of the High Energy Stereoscopic System (H.E.S.S.) and features the FlashCam camera system with more than 1500 pixels, which will also be utilised in the Cherenkov Telescope Array (CTA), a next-generation gamma-ray observatory.
We show that our deep-learning approach, based on Wasserstein Generative Adversarial Networks, can efficiently generate gamma-ray images with good quality. Besides analysing the distributions of low-level parameters, we further examine the quality of the generated images using the Hillas parameters, a well-known parameterisation of IACT images characterising the properties and the shape of the measured Cherenkov image. The finding that our algorithm is able to reproduce the correct distributions of the low-level and the Hillas parameters, as well as their correlations, opens promising perspectives for fast and efficient simulations in gamma astronomy.

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