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Using Conditional GAN to Control the Statistical Characteristics of the Generated Images from Imaging Atmospheric Cherenkov Telescopes

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Currently, generative adversarial networks (GANs) are a promising tool for image generation in the astronomy domain. Of particular interest are conditional GANs (CGANs), which allow you to divide images into several classes according to the value of some property of the image, and then specify the required class when generating images. In the case of images from Imaging Atmospheric Cherenkov Telescopes (IACT), an important property is the total brightness of all image pixels (image size), which is directly connected to the energy of primary particles. We used a CGAN technique to generate images of the Cherenkov telescope of the TAIGA-IACT experiment. As a training set, we used a sample of 2D images obtained using TAIGA Monte Carlo simulation software. We applied an artificial division of the images of the training set into 10 classes, sorting them by size and defining the boundaries of the classes so that the same number of images fall into each class. We then used these classes while training our CGAN. The paper shows that for each class, the size distribution of the generated images is close to normal with an average value located approximately in the middle of the corresponding class. We also show that for the generated images, the size distribution summed over all classes is close to the original distribution in the training set. The results obtained will be useful for data augmentation and more accurate generation of realistic synthetic images similar to the ones taken by IACT. This work was funded by the Russian Science Foundation (grant No. 22-21-00442).

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Authors: DUBENSKAYA, Yulia (SINP MSU); KRYUKOV, Alexander (SINP MSU); DEMICHEV, Andrey (SINP MSU); POLYAKOV, Stanislav (SINP MSU); ГРЕСЬ, Елизавета; VLASKINA, Anna (Moscow State University)

Presenter: DUBENSKAYA, Yulia (SINP MSU)

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