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Modeling detector digitization and read-out with adversarial networks

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Tools such as GEANT can simulate volumetric energy deposition of particles down to a certain energy and length scales.
However, fine-grained effects such as material imperfections, low-energy charge diffusion, noise, and read-out can be difficult to model exactly and may lead to systematic differences between the simulation and the physical detector.
In this work, we introduce a method based on Generative Adversarial Networks (GANs) that learns and corrects for these systematic effects.
The network transforms a simplistic GEANT simulation of a sensor into a realistic model that matches data from a physical sensor.
We also consider an extension of the GAN model based on Cycle-GAN, that allows for the introduction of explicit constraints on the network based on physical assumptions.
As a test case, we consider the simulation of cosmic ray interactions within mobile phone cameras, designed for use in the Cosmic RAYs Found In Smartphones (CRAYFIS) experiment. On the dataset from the experiment we demonstrate viability of the proposed approach and show it's competitive advantages over known so far methods.

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