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Pixel detector background simulation using generative adversarial networks at Belle II

The pixel vertex detector is an essential part of the Belle II experiment, allowing us to determinate the location of particle trajectories and decay vertices. The combined data from the innermost Pixel Vertex Detector (PXD), followed by the Silicon Vertex Detector (SVD), and the outermost Central Drift Chamber (CDC) are crucial in the event reconstruction phase to determine particle types, their tracks, and the decay chain. To model the effect of unwanted background noise on the track reconstruction in simulation, we add simulated or recorded background data to the simulated detector signals from the generated physics process of interest. A large batch of statistically independent samples of background noise is required to not be biased by statistical fluctuations in the background data. However, the data from the more fine-grained PXD alone is high in volume and requires a substantial amount of storage and bandwidth if we were to save all measurements. As an efficient way of producing background noise, we explore the idea of an on-demand noise generator which would produce samples statistically similar to the real background measurements and could be used in the reconstruction phase. We examine Generative Adversarial Networks (GAN) which have been extraordinarily successful in reproducing natural images and different types of datasets in various fields. In this talk, we present our progress with training GAN models on the PXD measurements of background noise, the quality of the generated samples compared to the real background data, and explore the effects of using generated noise in the reconstruction.

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