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Using Generative Adversarial Networks for fast simulations in the ALICE Experiment

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Data Quality Assurance (QA) is an important aspect of every High-Energy Physics experiment, especially in the case of the ALICE Experiment at the Large Hadron Collider (LHC) whose detectors are extremely sophisticated and complex devices. To avoid processing low quality or redundant data, human experts are currently involved in assessing the detectors'health during the collisions'recording. However, for Run 3 where the amount of collected data is 100 times higher, manual detector health checks will not be feasible.

To mitigate this problem, we use unsupervised machine learning methods, namely Generative Adversarial Networks (GANs), for fast simulations of trajectories reconstructed in the detector after particle collisions. We then compare the results of those simulations and physical parameters reconstructed in the detector to identify anomalies that might lead to the corruption of recorded data. Since GAN-based simulation is fast enough that it can be performed during runtime, our method allows for fully automatic online health checks of running conditions to be performed in real time. Furthermore, since GAN's parameters can be updated using incoming stream of data, our method can automatically adjust itself to changing conditions resulting, for example, from detector's aging.

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