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A Cellular Automaton tracking algorithm for the Upgrade of the Inner Tracking System of ALICE

In view of the LHC Run3 starting in 2021, the ALICE experiment is preparing a major upgrade including the construction of an entirely new inner silicon tracker (the Inner Tracking System) and a complete renewal of its Online and Offline systems.

During its Run3, LHC will deliver Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.5 TeV with a peak luminosity $L = 6 \times 10^{27}\, cm^{-2}\, s^{-1}$ and an interaction rate of 50 kHz, to be compared to the 8 kHz design interaction rate of the LHC Run1 and Run2. The aim of ALICE is to cope with such a high interaction rate improving at the same time the resolution and the efficiency of its silicon tracker.

In this context, one of the requirements for a prompt calibration of external detectors and a fast offline data processing is to run online the reconstruction of tracks in the Upgraded Inner Tracking System.

A new algorithm based on Cellular Automata has been developed to tackle this issue. In this algorithm the tracking is split in multiple phases to profit from data locality. At first, hit points are organised in sectors of azimuthal angle and longitudinal coordinate; then the algorithm looks for track segments within these sectors of the detector, independently. Track segments with compatible track parameters are marked as neighbours.

Neighbouring track segments are then merged at the final stage using a set of rules defined by the Cellular Automaton mechanism, somewhat similar to the set of rules used in the Conway's Game of Life.

The obtained computing and tracking performance are compliant with the requirements of ALICE being able to reconstruct tracks of transverse momentum down to 100 MeV/c in events with high track density ($\mathrm{d}N_{ch}/\mathrm{d}\eta$ up to 2000). The tracking and computing performance of this algorithm will be shown in the case of central Pb-Pb events at $\sqrt{s_{\mathrm{NN}}}$ = 5.5 TeV.

Preferred Track

Future Experimental Facilities, Upgrades, and Instrumentation

Collaboration

ALICE

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