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Testbeam results of the first real time embedded tracking system with artificial retina

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The retina experiment aims at developing a fast track finding system prototype for the high-luminosity LHC, capable to operate at 40 MHz event rate with hundreds of track per event. According to simulations this is technologically achievable by using the artificial retina algorithm, a massive parallel fast tracking algorithm, implemented in last generation commercial FPGAs. The artificial retina algorithm is inspired by neurobiology and is capable of pattern recognition and track fit. Hits from the tracking detectors are sent to a switch module routing the data to appropriate cellular units, the engines, that determine how well a set of hits matches with a specific track hypothesis. Finally a track fitter module interpolates the analog response of the engines and determines the track parameters with a resolution comparable with offline results.

A tracking prototype system based on 8 silicon strip detectors has been built as practical demonstrator of this innovative tracking system. The sensors are readout using Beetle chips, accepting trigger rates up to 1.1 MHz, and a custom data acquisition board based on new generation Xilinx Kintex7 FPGA. The retina algorithm has been implemented in the FPGA using a fully pipelined architecture and the embedded tracking system has been tested in a real experimental environment using protons at the CERN SPS facility. Testbeam results are presented and compared with simulations. Perspectives for the future are also discussed.

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