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An FPGA-Based Hough Transform Track Finder for the L1 Trigger of the CMS Experiment at the High Luminosity LHC

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A new tracking system is under development for operation in the CMS
experiment at the High Luminosity LHC. It includes an outer tracker which will construct
stubs, built by correlating clusters in two closely spaced sensor layers for the rejection of hits from low transverse momentum tracks, and transmit them off-detector at 40 MHz. If
tracker data is to contribute to keeping the Level-1 trigger rate at around 750 kHz under
increased luminosity, a crucial component of the upgrade will be the ability to identify
tracks with transverse momentum above 3 GeV/c by building tracks out of stubs. A
concept for an FPGA-based track finder using a fully time-multiplexed architecture is
presented, where track candidates are identified using a projective binning algorithm
based on the Hough Transform, and then refined with a Kalman Filter, fully implemented in FPGA. A hardware system based on the MP7 MicroTCA processing card has been assembled, which demonstrates a realistic
slice of the track finder in order to help gauge the performance and requirements for a full system. This talk
outlines the system architecture and algorithms employed, highlighting some of the performance and latency
results from the hardware demonstrator, and discusses the prospects and performance of the final system.

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