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Speeding up Particle Track Reconstruction using a Vectorized and Parallelized Kalman Filter Algorithm: Recent Improvements and Applicability to the Software Trigger

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Building particle tracks is the most computationally intense step of event reconstruction at the LHC. With the increased instantaneous luminosity and associated increase in pileup expected from the High-Luminosity LHC, the computational challenge of track finding and fitting requires novel solutions. The current track reconstruction algorithms used at the LHC are based on Kalman-filter methods that achieve good physics performance. By adapting the Kalman-filter techniques for use on many-core SIMD architectures such as the Intel Xeon and Intel Xeon Phi and (to a limited degree) NVIDIA GPUs, we are able to obtain significant speedups and comparable physics performance.

Recent work has focused on integrating the algorithm into the CMSSW environment for use in the CMS High Level Trigger during Run 3 of the LHC. New optimizations including the removal of hits from out-of-time pileup and improvements on the ranking of the hit candidates have further increased the speedup of the algorithm and improved the track-building efficiency. The use of advanced profiling techniques have identified additional areas to target for optimization. The current structure and performance of the code and future plans for the algorithm will be discussed.

Primary authors: CERATI, Giuseppe (Fermi National Accelerator Lab. (US)); ELMER, Peter (Princeton University (US)); GRAVELLE, Brian (University of Oregon); REINSVOLD HALL, Allison (Fermilab); KORTELAJNEN, Matti (Fermi National Accelerator Lab. (US)); KRUTELYOV, Slava (Univ. of California San Diego (US)); LANTZ, Steven R (Cornell University (US)); MASCIOVECCHIO, Mario (Univ. of California San Diego (US)); MCDERMOTT, Kevin (Cornell University (US)); NORRIS, Boyana; RILEY, Daniel Sherman (Cornell University (US)); TADEL, Matvez (Univ. of California San Diego (US)); WITTICH, Peter (Cornell University (US)); WUERTHWEIN, Frank (Univ. of California San Diego (US)); YAGIL, Avi (Univ. of California San Diego (US))

Presenter: REINSVOLD HALL, Allison (Fermilab)

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