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Fast, Parallel and Parametrized Kalman Filters for LHCb upgrade

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By 2020 the LHCb experiment will be upgraded to run at an, by a factor of 5, increased instantaneous luminosity of 2x10ˆ33 cmˆ-2 sˆ-1. The hardware trigger will be removed and replaced by a fully software based stage. This will dramatically increase the rate of collisions the software trigger system has to process. Additionally, the increased luminosity will lead to a higher number of tracks that need to be reconstructed per collision.
The Kalman filter, which is employed to extract the track parameters, currently consumes a major part of the reconstruction time in the trigger software and, therefore, needs further optimization.
We investigate two, noncompeting, strategies to speed up the current version of the filter. The first one is an algorithm that makes use of several different levels of SIMD instructions on different processor architectures to fit multiple tracks in parallel.
The second one is to replace the computational costly use of magnetic field and material look up tables, including a Runge-Kutta method for calculating the extrapolation, by simple parametrizations of every extrapolation step.
For both strategies details and performance studies are presented.

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