

An evaluation of the potential of GPUs to accelerate tracking algorithms for the ATLAS trigger

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The potential of GPUs has been evaluated as a possible way to accelerate trigger algorithms for the ATLAS experiment located at the Large Hadron Collider (LHC). During LHC Run-1 ATLAS employed a three-level trigger system to progressively reduce the LHC collision rate of 20 MHz to a storage rate of about 600 Hz for offline processing. Reconstruction of charged particles trajectories through the Inner Detector (ID) was performed at the second (L2) and third (EF) trigger levels. The ID contains pixel, silicon strip (SCT) and straw-tube technologies. Prior to tracking, data-preparation algorithms processed the ID raw data producing measurements of the track position at each detector layer. The data-preparation and tracking consumed almost three-quarters of the total L2 CPU resources during 2012 data-taking.

Detailed performance studies of a CUDATM implementation of the L2 pixel and SCT data-preparation and tracking algorithms running on a Nvidia® Tesla C2050 GPU have shown a speed-up by a factor of 12 for the tracking code and by up to a factor of 26 for the data preparation code compared to the equivalent C++ code running on a CPU. A client-server technology has been used to interface the CUDATM code to the CPU-based software, allowing a sharing of the GPU resource between several CPU tasks.

A re-implementation of the pixel data-preparation code in openCL has also been performed, offering the advantage of portability between various GPU and multi-core CPU architectures.

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