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GPU for triggering in High Energy Physics Experiments

General Purpose Graphical Processing Units (GPGPU) provide exceptional massive parallel computing power with small power consumption. GPGPU bring high performance computing with off-the-shelf products. However the full exploitation of this new computing paradigm will not be possible if software applications only partially employs massive parallelism.
High Energy Physics experiments have much to gain adopting this new computing paradigm. In fact,
the expected gain in performance both in reducing the application latency or in dealing with the data high throughput increase will allow to employ systems based on GPGPU for data acquisition increasing the available computing power with smaller electric power consumption. All these features are very interesting for using GPGPU at trigger level in an on-line environment to provide fast decision and high rejection power.

In view of possible applications in a trigger system we will show, using realistic examples based on data from current LHC High Energy Physics experiments, the improvement in performance of typical HEP intensive computing applications after tuning and optimization for running on GPGPU. The methodology to improve the performance will also be shown together with results using different GPGPU architectures.

In particular the porting to GPGPU architecture of two typical HEP reconstruction algorithms will be shown: tracking in the inner detector and jet clustering in the calorimeter.

Tracking in the very dense LHC environment is very challenging with multiple minimum bias interactions superimposed to the high transfered momentum one. Both pattern recognition and track fitting would benefit from massive parallelism for high troughput processing that can be fully exploited at trigger level.
Also jet clustering with the very fine granularity of LHC experiments calorimetry would profit from the massive parallelism offered by GPGPU.

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