

GPU-based track quasi-real-time track recognition in imaging devices: from raw data to particle tracks

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Nuclear emulsions as tracking devices suitable for high-energy physics experiments have been recently used by CHORUS, DONUT, PEANUT and OPERA. High statistics is accessible by fast automatic microscopes for emulsion readout. Former systems had to do most processing by the CPU; the next generation, entering duty at the present time, is based on GPU's. Automatic microscopes need real-time 2D imaging to drive the motion of the microscope axes using feedback from images; 3D track recognition occurs quasi-online (continuous buffered stream), in local clusters of computing servers based on GPU's. The proposed contribution shows the status of the Quick Scanning System (QSS), an evolution of the ESS currently used in OPERA and for muon radiography on volcanic edifices. Compared to vision processors, GPU's provide at least a factor 4 speed-up, and a factor 16 or better if the comparison includes cost. A short account is given of the hardware setup of the system, while the presentation mostly focuses on:

- 1) 2D image processing on-the-fly at the data rate of about 2 GB/s on a single workstation;
- 2) 3D tracking algorithm and the related computing power distribution and balancing technique;
- 3) Local clusters of GPU-based tracking servers.

Many aspects of the algorithms shown are not specific to the application, but tackle common problems of particle tracking in high-energy physics experiments.

An outlook of the future evolution and applications of the QSS is given.

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