

# A Pattern Recognition Scheme for Large Curvature Circular Tracks and Its FPGA Implementation Using Hash Sorter

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In today's colliding detectors such as CMS, strong magnetic field causes large curvatures of tracks in the  $r-\phi$  plane. Track recognition, especially for the middle and low transverse momentum ones, becomes more difficult

To overcome the difficulties due to large track bending, we investigated a global track recognition scheme using no approximation in the track equation. In a small region of the detector, if the tangent angle  $\alpha$  of the track segment (or "cluster", or "doublet") can be measured, the two track parameters,  $\alpha_0$  and  $1/R$  can be calculated very simply without any approximation.

After calculating  $\alpha_0$  and  $1/R$  of the doublets, the doublets are stored into an array of bins indexed by these two track parameters, or, one may visualize this as booking a 2-D "histogram". The doublets that belong to a track must all have common parameters. Therefore the doublets from one track will be primarily found in one bin (plus its neighboring bins to account for the boundary effects). The grouped doublets are then sent to later stages for track reconstruction and multiple track separation.

A simple simulation has been done for a CMS-like detector in which the track tangent angles were measured coarsely with 10mrad full width of error (i.e., 50 $\mu$ m pitch silicon detectors with 1cm spacing). After booking the doublets into 2-D bin array with emulated hash sorters in C-code, more than 99.9% tracks were recognized for events with 100-1000 tracks. The multiple-track overlapping rate was controlled within a few percents for the 1000-track events.

We should point out that when we book the 2-D "histogram", one doublet is booked into only one bin, rather than a set of bins. This allows very simple FPGA implementations using "hash sorter" as the storage bin array. The hash sorter is designed to match the data fetching speed and to use memory resource in the FPGA efficiently.

