Hough Transform: Serial and Parallel Implementations

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Introduction

Hough Transform(HT)[1][2] is an established technique for finding boundaries/edges in different types of shapes. Heavily used (as one of the embedded techniques) in facial features matching tools, this algorithm has its origin from the days of bubble chamber experiments used then for finding straight tracks/curves. We would like to present this algorithm from the perspective of a similar problem of finding tracks in the INO-ICAL (India based Neutrino Observatory – Iron CALorimeter) detector, which would be coming up soon in the Western Ghats. Classical Hough transform was concerned with the identification of lines in the image, but later on Hough transform has been extended to identifying positions of arbitrary shapes like circles, parabola etc. Now-a-days lots of versions have made into the Hough transform algorithm. The most common are kernel-based Hough transform and the generalized Hough transform. Although we do have good tracking code like: Kalman filter and Cellular Autometa but in order to minimize the track finding and coarse reconstruction time we can switch to Hough transform technique easily.

Implementations: Serial and Parallel

The serial Hough Transform has already been in use in various present day High Energy Physics experiments. We have tested the same in the INO-ICAL scenario as well[3]. The easy availability of the parallel computing tools now-a-days on the desktops as well as the High Performance Computing Cluster (HPCC) at the Physics Department has motivated us to go ahead with the parallelization of the HT algorithm and learn the gains and the improvements. The accuracy of the Hough transform depends on accumulator cells and the bin size. In this paper we would like to present these studies being undertaken at Panjab University as part of the INO-ICAL collaboration initiated studies by using the simulated data and comparing with the standard INO-ICAL code.

Hough Transform: At Work

The flow diagram, both for the Serial as well as the Parallel version of the Hough Tranform algorithm is given below. This is given for the simple case of a straight line track finding.

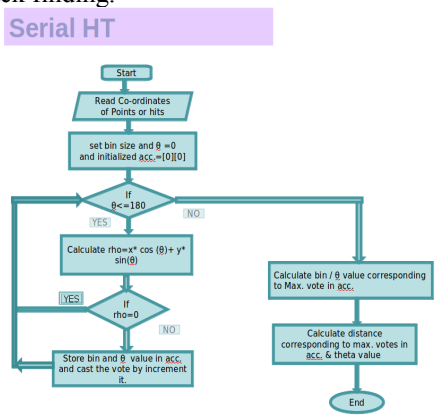

Fig. 1 Serial Hough Transform Algorithm

The parallelization of the Hough Transform algorithm is done in the MPICH implementation of the parallel environment under the Centos Operating System running on the HPCC.

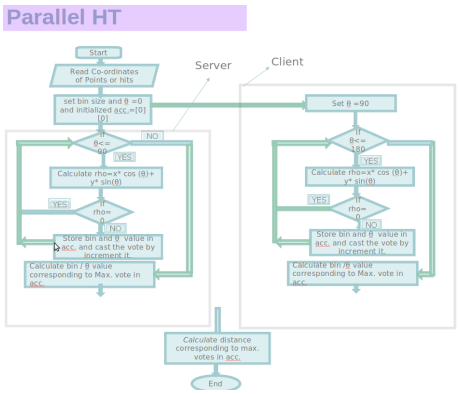

Fig. 2 Parallel Hough Transform Algorithm

References

[1] P.V.C. Hough, *Machine Analysis of Bubble Chamber Pictures,* Proc. Int. Conf. High Energy Accelerators and Instrumentation, 1959.

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