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Parallelization of likelihoood function data analysis software based on RooFit package

With the startup of the LHC experiments, the community will be focused on the data analysis of the collected data. The complexity of the data analyses will be a key factor to find eventual new phenomena. For such a reason many data analysis tools are being developed in the last years. allowing the use of different techniques, such as likelihood-based procedures, neural networks, boost decision trees. In particular the likelihood-based procedures allow the estimation of unknown parameters based on a given input sample. Complex likelihood functions, with several free parameters, many independent variables and large data sample, can be very CPU-time consuming for their calculation. Furthermore for a good estimation it is required the generation of several simulated samples of events from the probability density functions, so the whole procedure which can be CPU-time consuming. In this presentation I will show how the likelihood calculation, the normalization integrals calculation, and the events generation can be parallelized using MPI techniques to scale over multiple nodes or multi-threads for multi-cores in a single node. We will present the speed-up improvements obtained in typical physics applications such as complex maximum likelihood fits using the RooFit and RooStats packages. We will also show results of hybrid parallelization between MPI and multi-threads, to take full advantage of multi-core architectures.

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