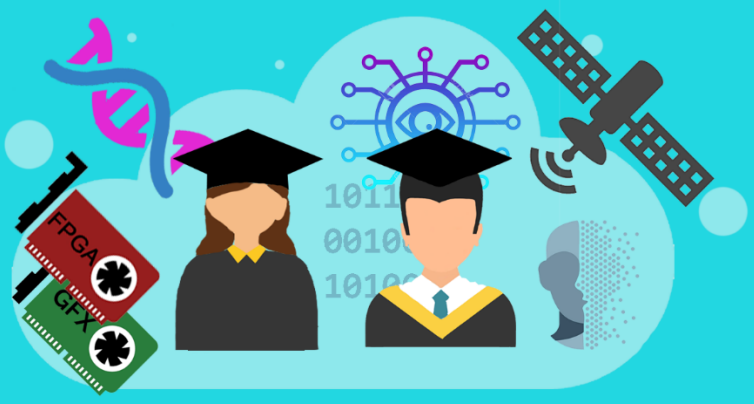
Diploma Thesis

Microproccessors and Digital Systems Laboratory

Academic year 2019-2020



Heterogeneous CPU-GPU Acceleration of the Scientific Simulator Suite BLonD

The Beam Longitudinal Dynamics code BLonD is a unique simulation code developed at CERN in the BE-RF group to model beam motion in synchrotrons. BLonD simulations contribute to determining the baseline parameters for important upgrades and future concepts. The code is written in a modular fashion, so that the physics content of each simulation can be adapted to special purposes via pipelining different modules. The code was originally developed in python and its computational core has been now translated to C++ to speed up its runtime and apply different optimization techniques like multithreading and vectorization for each module. Furthermore, to deal with the increasing input requirements of the diverse BLonD applications, **a distributed MPI-over-OpenMP** version of the code has been implemented, optimized and benchmarked.

GPUs, due to their computational power and power efficiency, have become the de-facto standard to accelerate general-purpose workloads. The computational core of the code BLonD is inherently parallel and as a result, forms an ideal candidate for GPU acceleration.

Towards this direction, our lab is supporting a diploma thesis which will aim to **integrate GPU acceleration** into the existing distributed version of the code BLonD. The desirable outcome of the thesis would be a solution that combines (i) MPI to co-ordinate the operation of multiple computing nodes, with (ii) a synergistic, heterogeneous, CPU-GPU computation core. The CPU-GPU communication overhead will have to be carefully examined and confined. The successful candidate will have the chance to collaborate and exchange with an international group of highly-skilled scientists based at CERN. Enabling faster, larger scale and more complex BLonD simulations will assist scientists in accelerator complexes around the world to advance our understanding of particle accelerators, and through them, the fundamental structure of the universe.

Required Qualifications: Parallel Programming, C, CUDA, MPI, Object Oriented Programming.

Desirable Qualifications: Python, C++, Git, Bash, Familiarity with Linux.

Academic Advisors:

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