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AdePT –Offloading Electromagnetic Showers in Geant4 Simulations to GPUs

The simulation throughput of LHC experiments is increasingly limited by detector complexity in the high-luminosity phase. As high-performance computing shifts toward heterogeneous architectures such as GPUs, accelerating Geant4 particle transport simulations by offloading parts of the workload to GPUs can improve performance. The AdePT plugin currently offloads electromagnetic showers in Geant4 simulations to GPUs, making an efficient CPU–GPU workflow essential. In this contribution, we present state-of-the-art detector simulations for LHC experiments leveraging GPU acceleration, and report on the integration of AdePT into the software frameworks of the LHC experiments. The remaining challenges and future directions are also discussed.

Significance

In the last year, a novel kernel scheduling approach has been implemented in AdePT. These new asynchronous CPU-GPU workflow has drastically improved performance when scaling to many CPU threads, a critical requirement for being competitive with pure Geant4 simulations. This new approach has additionally enabled to copy back all steps done on the GPU to the CPU without loss of performance. This enables calling custom user code on each step, another critical requirement by the experimental frameworks of the LHC experiments.

References

AdePT has been recently reviewed in an assessment, where it outperformed significantly its competitor in the most challenging examples: https://indico.cern.ch/event/1507476/

Experiment context, if any

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