Track reconstruction

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004761.

Introduction

- Last tracking report was 6 months ago
  - No WP12 meeting since march annual meeting
- A **massive** amount of work was done at CERN (large org!)
  - No hope to give even a fair *summary* in 12 minutes
- Thus, this will be a dense & fast sequence of biased highlights
  - Links to extra information (usually PR) provided
  - Picks based on perceived importance, mistakes are mine

General CERN highlights

- Gaussian Sum Filter integrated
- Exa.TrkX plugin integrated + various improvements
- New kd-tree based seeding merged
- Generic MultiTrajectory storage (for e.g. xAOD integration)
- GPU CI for Acts + vecmem + detray (WIP for traccc)
- SVG geometry display (shared with detray)
- Lots of docs improvements before (ongoing) Acts workshop

AIDA-related highlights & future work

- No need for ActsExtension in DD4hep detectors anymore
  - Contributed dd4hep::MapStringVariantStruct to DD4hep
- Minimal EDM4hep I/O support merged in
- And there are more ongoing developments
  - Finite State Machine navigator
  - Material mapping auto-tuning (see next slide)

Algorithm auto-tuning @ IJCLab

- Early auto-tuned material map on the Open Data Detector
  - Track material usually <5 % away from truth
  - Expect better through more iterations / other algorithms
- Plan to communicate on this work through several venues
  - IN2P3/IRFU ML @ APC
  - ACAT (poster)
  - CHEP (+ also ambiguity resolver ?)

+ Corentin also convener of ML @ ACTS

GPU R&D : vecmem

- Optimized memset function
- Jagged vector data transfer optimization
- Buddy allocator optimization
- Significantly improved handling of allocation alignment

GPU R&D : detray (and covfie)

- New features :
  - Step size constraints
  - Covariance transport
  - Material handling
- WIP integration of covfie
  - New project for magnetic field handling in GPU R&D

GPU R&D : traccc

- SYCL clusterization and seed finding merged in
- FastSV CUDA clusterizer merged in
- Lots of EDM refactoring + CUDA/SYCL code sharing
- Ongoing :
  - Porting several algorithms to Futhark language
  - CUDA opts/algs : module map, flat EDM, seeder, CCA

MPGD @ INFN

- Tuning fast simulation to experimental data / Monte Carlo
- Started experimenting with machine learning algorithms
  - Defining variable lists, etc
- About to retry hiring a post doc

Kiwaku

- Sylvain Joube's work refocused on Kiwaku
- C++20 multidimensional array library
  - Leverages new standard (esp. concepts) for ergonomics
  - Provides basic algorithms + element walk
  - To be completed with GPU (via SYCL), OpenMP support
- Application to HEP tracking planned → will submit to CHEP

Software optimization

- « crofiler » **compilation profiling** project progressing nicely
  - Last big missing piece is better C++ name simplification
  - Demoed at ACTS workshop
- GSoC work on **faster low-dimensional algebra**
  - Studied improvements in state of the art since last attempts
  - Newly discovered fastor library very promising in µbenches
  - Will now compare it to Eigen in more realistic tracking code
- Meanwhile, CERN working around bad Eigen gemm @ Acts

Conclusions

- 6 months of work is too much for this small time slot :)
- As usual, skipping on many other important tasks
  - Bugfixes
  - Quality of life improvements
  - Code refactorings

Backup

Material mapping optimization