Track reconstruction @ CERN & IJCLab

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2023-04-24

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

Acts core : Geometry

- Removed need for ActsExtension in DD4hep detectors
- SVG geometry display (shared with detray)
- Ongoing work towards detray-like layerless geometry in Acts
- Lots of work on Geant4 bugs, including better GDML import

Acts core : I/O and event data

- Generic MultiTrajectory storage (for e.g. xAOD integration)
- EDM4hep support introduced, improved in #2001 #2022
- More memory-efficient measurement storage
- Ongoing work on public Track EDM

Acts core : Seeding

- **Lots** of work on seeder speed (cuts, code optimization)
- K-d tree based seeding integrated
- Hough transform integrated
- Truth seeding completely rewritten

Acts core : Track finding & fitting

- Gaussian Sum Filter integrated, refined throughout the year
- Exa.TrkX ML track finding integrated, CI'd, being modularized
- Global χ^2 fitter integrated

Acts core : Infrastructure, misc

- GPU CI for Acts, vecmem, detray, traccc
- Ambiguity resolver integrated, optimized
- Test Athena build on every main branch commit
- Early C++20 support, primary CI target is now Ubuntu 22.04
- Tests of public headers in algebra-plugins, vecmem
- Many other doc improvements, refactors, bugfixes, speedups…

ML tracking R&D @ IJCLab

- Done :
  - Material mapping autotuning (ACAT 2022, CHEP 2023)
  - ML-based ambiguity solver (CHEP 2023)
- Planned :
  - Run ambires on seeder output (not much info to work with, but given we have 100 seeds / truth track, might still help ?)
  - ML seeder that outputs track parameters, not triplets

R&D : algebra-plugins

- Used GSoC to investigate alternatives to Eigen
  - Fastor proved most interesting (~3x faster in µ-benches)
  - Was recently integrated, enables more realistic benches
- Other news :
  - LU-based matrix inversion
  - SYCL tests
  - WIP work on SoA batches of 3D vectors : #95 #97

R&D : vecmem

- Optimizations : #177 #178 #187
- Alignment handling improvements : #181 #191 #192
- Small API improvements: #197 #224 #229
- Compiler and SYCL2020 support : #203 #204 #218
- Asynchronous data transfers
- Public doxygen documentation page
- Atomics support : better tests, local memory

R&D : detray

- Geo building refactored, aiming for core Acts geo support
- Propagation : step constraints, covariance transport, material
  - CUDA optimizations : avoid thrust::sort, tune launch config
- B-Field via covfie, another Acts R&D project
- Lots of work on navigation : #283 #290 #367 #370 #392 #398
- Parallel CPU benchmarks via OpenMP
- Surface barcodes for accelerator structure lookup : #423 #448

R&D : traccc

- CUDA : FastSV clustering, (C)KF from Berkeley*
- SYCL : clustering, seed finding
- Continued effort on on making these share code, e.g. #377
- Evaluating various other options : Futhark, Kokkos, Alpaka...
- Optimizations : faster kernels, alloc reuse, async memcpy...
  - Recent highlight : reworked EDM → 60 % speedup
- Recently got proper CPU benchmarks, enabling comparisons

* Not to be claimed as an AIDAinnova contribution, but an important project milestone

Misc R&D @ IJCLab

- « crofiler » compilation profiler now has binary releases
- Sylvain working on « kiwaku » N-d array library
  - Numpy-like design (focused on arrays + iteration)
  - Leverages C++20 for ergonomics
  - Will present application to HEP use cases at CHEP 2023

Thanks for your attention !