Contribution ID: **450** Type: **Oral**

The ACTS project: track reconstruction software for HL-LHC and beyond

Tuesday 5 November 2019 17:30 (15 minutes)

The reconstruction of trajectories of the charged particles in the tracking detectors of high energy physics experiments is one of the most difficult and complex tasks of event reconstruction at particle colliders. As pattern recognition algorithms exhibit combinatorial scaling to high track multiplicities, they become the largest contributor to the CPU consumption within event reconstruction, particularly at current and future hadron colliders such as the LHC, HL-LHC and FCC-hh. Current algorithms provide an extremely high standard of physics and computing performance and have been tested on billions of simulated and recorded data events. However, most algorithms were first written 20 years ago and maintaining them has become increasingly challenging. In addition, they are challenging to adapt to modern programming paradigms and parallel architectures.

ACTS is based on the well-tested and highly functioning components of LHC track reconstruction algorithms, implemented with modern software concepts and inherently designed for parallel architectures. Multithreading becomes increasingly important to balance the memory usage per CPU core. However, a fully multi-threaded event processing framework blurs the clear border between events, which has in the past often been used as a clearly defined validity boundary for event conditions. ACTS is equipped with a full contextual conditions concept that allows to run concurrent track reconstruction even in case of multiple detector alignments, conditions or even varying magnetic field being processed at the same time.
It provides an experiment and, in particular, framework-independent software core with key tools and lightweight, highly optimised event data model for track reconstruction. Particular care is given to thread safety and data locality. It is designed as a toolbox that allows to implement and extend widely known pattern recognition algorithms, and in addition suitable for algorithm templating and R&D. ACTS has also used as the fast simulation engine for the Tracking Machine Learning Challenge, and will provide reference implementation of several submitted solution programs of the two phases of the challenge.

We discuss the current status of the ACTS project. We will present studies of the physics and computing performance based on the upcoming first full release. We will discuss challenges in the development of experiment-independent algorithms and illustrate this, by discussing prototype studies of its use in experiments ranging from test-beam to Belle, LHC experiments, CEPC and FCC-hh reference detectors. We will also compare performance between different algorithms, including those based on machine learning.

Consider for promotion

No

Primary authors: GRAY, Heather (LBNL); SALZBURGER, Andreas (CERN); KIEHN, Moritz (Universite de Geneve (CH)); LANGENBERG, Robert Johannes (CERN); KLIMPEL, Fabian (Max-Planck-Institut fur Physik (DE)); SCHLAG, Bastian (Johannes Gutenberg Universitaet Mainz (DE)); ZHANG, Jin (Chinese Academy of Sciences (CN)); GESSINGER-BEFURT, Paul (CERN / JGU Mainz); XIAOCONG, Ai; GRASLAND, Hadrien Benjamin (Centre National de la Recherche Scientifique (FR))

Presenter: GESSINGER-BEFURT, Paul (CERN / JGU Mainz)

Session Classification: Track X –Crossover sessions

Track Classification: Track X –Crossover sessions from online, offline and exascale