

# IRIS-HEP Fellowship Proposal: Dr. Tomohiro Yamazaki

Mentor: Prof. Heather Gray (UC Berkeley)

A Common Tracking Software (ACTS) is an international, open-source project developing an experiment-independent set of track reconstruction tools. The main philosophy is to provide high-level track reconstruction modules that can be used for any tracking detector. The description of the tracking detector's geometry is optimized for efficient navigation and quick extrapolation of tracks. Converters for several common geometry description languages are included. Having a highly performant, yet largely customizable implementation of track reconstruction algorithms is a primary objective for the design of this toolset. Additionally, the applicability to real-life HEP experiments, such as the upgrade of the ATLAS experiment for the HL-LHC, has played and continues to play a major role in the development process. Apart from the algorithmic code, this project also provides an Event Data Model (EDM) for the description of track parameters and measurements.

Currently, the key elements of the tracking infrastructure, e.g. tracking geometry and navigation, track parameter propagation engine, and tracking EDM, have been much consolidated. The tracking features like track fitting, track finding and vertex reconstruction have been available yet significant validation work still remains. To date, the performance of those tracking algorithms has mostly been tested with the TrackML detector, which has a significantly simplified detector layout and material description. This is not sufficient to fully validate the performance of the sets of tracking tools. In addition, the geometry of the ATLAS detector has recently been implemented in ACTS, however, the tracking performance of those newly implemented tracking algorithms, e.g. Kalman Filter (KF) and Combinatorial Kalman Filter (CKF), has not yet been tested with the ATLAS detector. During this fellowship, I plan to validate the performance of the ACTS track finding and fitting on the ATLAS ITk detector.

This task of validating ACTS performance using the ATLAS ITk can be broken into a few steps:

- 1) Discussion with Moritz Kiehn about the status of the digitization chain and help implement the missing pieces that break the digitization in ACTS test framework (week 1-4)
- 2) Run the simulation and reconstruction with the implemented ATLAS ITk detector (week 5-7)
- 3) Test the performance of ACTS KF and CKF with ATLAS ITk (week 8-10)
- 4) Perform initial studies of an ML-based track selection algorithm for tuning CKF selection cuts for the ATLAS detector (week 11-12)

References:

1. Ai, Xiaocong, Tracking with ACTS, Connecting the Dots 2020, [https://indico.cern.ch/event/831165/contributions/3717113/attachments/2024363/3396410/ACTS\\_CTD\\_Xiaocong.pdf](https://indico.cern.ch/event/831165/contributions/3717113/attachments/2024363/3396410/ACTS_CTD_Xiaocong.pdf)
2. Ai, Xiaocong, Track finding/fitting with ACTS, IRIS-HEP Topical Meeting, [https://indico.cern.ch/event/889047/contributions/3749030/attachments/1990315/3319040/IRIS\\_HEP\\_topical\\_meeting\\_Xiaocong.pdf](https://indico.cern.ch/event/889047/contributions/3749030/attachments/1990315/3319040/IRIS_HEP_topical_meeting_Xiaocong.pdf)