TDAQ group report

A. Gioiosa (Pisa), G. Pezzullo (Yale)

for the Mu2eII tdaq subgroup

Outline

- Achievements to date
- Plan

Architectures under study

Two TDAQ architectures proposed so far:

1. **2-level Trigger (L1 Trigger + HLT)**
   a. do some processing on FPGA and the remainder on software
   b. **where are the boundaries?**
   c. **can we make a L1 trigger decision at FPGA level?**
   d. **track pattern-recognition on FPGA?**
   e. **Need to develop FPGA algorithms**
2. Software Trigger using GPUs
   a. Exploring more in detail the evolute Track-Fit algorithm using a tool that allows to estimate performance gain from parallelization with minimal changes to the code: https://www.openacc.org/tools. In more detail we want to try using the KinKal package for testing it: https://github.com/KFTrack/KinKal
   b. Interface with artdaq? Starting referring to the paper: GPU-accelerated machine learning inference as a service for computing in neutrino experiments

L1 + High Level Trigger

- Aggregate the data into a board equipped with multiple FPGAs
- Run the early stage of the track reconstruction + full calorimeter reconstruction
- Apply a L1 decision and move data to the HLT farm which runs full track reco

L1 + High Level Trigger: where do we stand?

- Jinyuan Wu illustrated a possible algorithm that can be implemented on FPGA
  - Need to access performance with simulated data
- Ryan illustrated to Richie and I how to use Vivado for doing development using High Level Synthesis
- Robert Soleti recently showed interest in doing development with HLS4ML
- Ideally, part of this development could be used/tested already in Mu2e
- We made a contribution to a white paper: **Applications and Techniques for Fast Machine-Learning in Science** – N. Tran et al., to be submitted on <u>Big Data and AI in High Energy Physics</u>

- Richie Bonventre will give a talk to CPAD. Thank you Richie :-)!

Plan to restart looking into it in April

Software Trigger on GPUs

- Antonio and I have been in contact with Gianluca Lamanna from Pisa
- He suggested us a way to make preliminary tests using **OpenAcc** to parallelize KinKal package
- Plane to start working on it after in April