Joel Greer

University of Bristol

Research Area: DAQ and Triggering

Project title:

Machine Learning for the Deep Underground Neutrino Experiment (DUNE)

About me:

I studied an integrated Master's at the University of Bristol and graduated in 2018 with an MSci in Physics (2i). During my undergraduate course I worked on projects including the computer identification of stomata in images of leaves and the use of optical tweezers to study sugar concentrations in cells. I enjoyed being able to study a diverse range of topics, from quantum biology to galaxy formation. Beyond work I enjoy relaxing by reading history books and doing archery.

Science/research area:

DUNE will comprise of two neutrino detectors which will be placed in the world's most intense neutrino beam, produced at Fermilab, Illinois. There will be a near detector to determine the neutrino beam properties and a far detector located 1300km away and 1.5km underground at the Sanford Underground Research Facility in South Dakota.

The FD will be composed of four 10 kilotonne liquid argon time projection chambers. These use a large volume of cryogenically cooled liquid argon in a strong electric field to act as a target for incoming particles.

I work as part of the DUNE far detector (FD) data acquisition (DAQ) group.

I work on:
Simulation studies of the detector response which will help to establish the best approaches for triggering on a range of physical phenomena. I have been working on the supernova trigger for the detector and performing simulation studies for the level 1 (L1) trigger.
These software based studies support the development of a field programmable gate array (FPGA) based L1 trigger in Bristol. I am also involved in the commissioning and running of new firmware for the timing system for ProtoDUNE, an engineering prototype of the DUNE FD, which is based at CERN. We are also working towards demonstrating FPGA based triggering with ProtoDUNE.

In addition to these areas I intend to go on and do studies using ML techniques to optimise the SN trigger in addition to other areas which may include minimisation of detector noise. There are a large number of other opportunities to apply ML techniques in this experiment, for example, in the reduction of noise in the detector.

Data Intensive Research Skills and Interests:

Current Skills: C/C++, Python, databases, data visualization, linux/unix, Monte-Carlo methods/simulation, basic parallel programming (OpenMP, Open MPI), latex typesetting.
Expected Future Skills: Tensorflow/keras for ML, plenty of use of scipy/pandas, hands on experience with custom electronics systems and FPGAs for data-processing and control.
Interests: Neural net and decision tree based studies and FPGA based applications of ML.