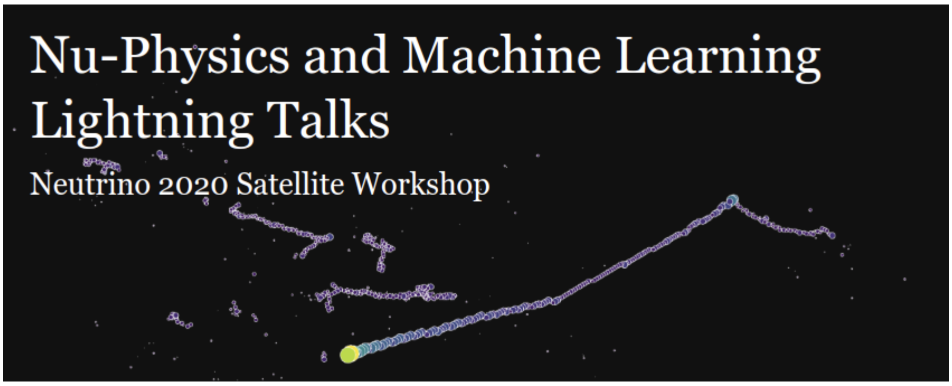
Neutrino Physics and Machine Learning (NPML): Lightning Talks



Report of Contributions

https://indico.slac.stanford.edu/e/377

Contribution ID: **3** Type: **not specified**

A Machine Learning Approach to Study the Neutrino Charged-current Interaction on 127I

Wednesday, 17 June 2020 11:00 (15 minutes)

An inclusive measurement of the cross section of the neutrino charged-current interactions on 127I will help study the quenching of gA , the axial-vector coupling constant, which determines the rate of neutrinoless double beta decays. At the Los Alamos Meson Production Facility (LAMPF), an exclusive measurement was made but with a large statistical error. To make an inclusive and more accurate measurement, a 185 kg NaI[Tl] prototype was deployed by the COHERENT collaboration. To reduce the major background, cosmic rays, a machine learning model based on a convolutional neural network (CNN) is being developed. The model, tested with simulations, can remove 78% of the backgrounds while preserving 77% of the cc signals.

Primary author: Mr AN, Peibo (Duke University)

Presenter: Mr AN, Peibo (Duke University)

Session Classification: Day 1: Morning

Contribution ID: **5** Type: **not specified**

Using Convolutional Neural Network for Pulse Shape Discrimination in Liquid Argon

Wednesday, 17 June 2020 13:30 (15 minutes)

The COHERENT collaboration utilizes a suite of detectors to search for CEvNS and associated backgrounds at the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory. CENNS-10, a single-phase liquid Ar detector operating since the spring of 2017, seeks to measure the CEvNS process in Ar. Standard pulse-shape discrimination in Ar makes use of the characteristic scintillation emission timescales to differentiate between gamma/electron-induced events (ER) and nuclear recoils (NR), but the efficacy of this method begins to degrade at lower energies as photon statistics decrease. Machine learning methods which use all information from event waveforms may be capable of improving discrimination at lower energies. This talk will detail an investigation into the usefulness of using a convolutional neural network to discriminate between NR and ER events in CENNS-10.

Primary author: DAUGHHETEE, Jacob (University of Tennessee)

Presenter: DAUGHHETEE, Jacob (University of Tennessee)

Session Classification: Day 1: Afternoon

Contribution ID: **6** Type: **not specified**

Efficient neutrino oscillation parameter inference using Gaussian processes

Friday, 19 June 2020 13:15 (15 minutes)

The unified approach of Feldman and Cousins allows for exact statistical inference of small signals that commonly arise in high energy physics. It has gained widespread use, for instance, in measurements of neutrino oscillation parameters in long-baseline experiments. However, the approach relies on the Neyman construction of the classical confidence interval and is computationally intensive as it is typically done in a grid-based fashion over the entire parameter space. In this article, we propose an efficient Bayesian optimisation algorithm for the Feldman-Cousins approach using Gaussian Process to construct confidence intervals iteratively. We show that in the neutrino oscillation context, one can obtain confidence intervals fives times faster in one dimension and ten times faster in two dimensions, while maintaining an accuracy above 99.5%.

Primary author: Mr NAYAK, Nitish (University of California-Irvine)

Co-authors: Mr LI, Lingge (University of California-Irvine); Prof. BIAN, Jianming (University of California-Irvine); Prof. BALDI, Pierre (University of California-Irvine)

Presenter: Mr NAYAK, Nitish (University of California-Irvine)

Session Classification: Day 2: Afternoon

Contribution ID: **7** Type: **not specified**

A Convolutional Neural Network for Multiple Particle Identification in the MicroBooNE LArTPC

Friday, 19 June 2020 11:30 (15 minutes)

MicroBooNE has accumulated data in a 1E21 POT neutrino beam over five years to test the excess of low energy electron neutrino-like events observed by MiniBooNE. To this end, we have explored the use of a new hybrid analysis chain that includes both conventional and machine learning reconstruction algorithms to identify events with the exclusive 1-proton-1-electron signal topology. The multiple-particle-identification (MPID) network we developed is an important application of convolutional neural networks that takes a reconstructed image as input, and provides simultaneous probabilities of having a proton, electron, gamma, muon or charged pion in the image. MPID shows a promising ability to separate the physical features that distinguish interactions, e.g., protons in ν_μ events, and gamma showers from π^0's in ν_eCC interactions. In this talk, we present the highlights of MPID training and performance in both simulated and real datasets.

Primary author: AN, Rui (Illinois Institute of Techonology)

Presenter: AN, Rui (Illinois Institute of Techonology)

Session Classification: Day 2: Morning

Contribution ID: **8** Type: **not specified**

Reconstructing Michel Electrons in ICARUS with Deep Neural Networks

Wednesday, 17 June 2020 14:00 (15 minutes)

Deep neural networks (DNN) enabled countless breakthroughs in the fields of artificial intelligence and computer vision and they have been successfully applied to the data reconstruction of Liquid Argon Time Projection Chambers (LArTPC), which offer high resolution (~3mm/pixel) 2D or 3D imaging of charged particles' trajectories. The ICARUS detector is a large-scale (760-ton) LArTPC far detector for the Short Baseline Neutrino program, currently being commissioned at Fermilab. In this poster, we present DNNs for pixel-level particle type classification and prediction of particle start and end points, specifically designed for sparse LArTPC data, as a part of a full DNN-based data reconstruction chain developed by the SLAC group. We study their application in ICARUS to the reconstruction of a Michel electron, a commissioning analysis target for the calibration of the low energy electromagnetic showers.

Primary authors: DOMINE, Laura (Stanford University); TERAO, Kazuhiro (SLAC); TSANG, Patrick (SLAC); Dr USHER, Tracy (SLAC)

Presenter: DOMINE, Laura (Stanford University)

Session Classification: Day 1: Afternoon

Contribution ID: **10** Type: **not specified**

Shower Reconstruction in Liquid Argon Time Projection Chambers using Graphical Neural Networks

Friday, 19 June 2020 13:30 (15 minutes)

Liquid Argon Time Projection Chambers (LArTPCs) are a class of detectors that produce high resolution images of charged particles within their sensitive volume. The identification and clustering of electromagnetic (EM) showers in LArTPCs is of central importance to the current and future neutrino physics program. EM activity typically exhibits spatially detached fragments of varying morphology and orientation that are challenging to efficiently assemble using traditional algorithms. Graphical Neural Networks (GNNs) were developed in recent years to find correlations between objects embedded in an arbitrary space. GNNs are studied with the goal of predicting the adjacency matrix of EM shower fragments and to identify the origin of showers, i.e. primary fragments. The energy resolution of the showers assembled with GNNs is presented and the reconstruction of the mass of neutral pions is used as a test case to further validate the algorithm.

Primary author: DRIELSMA, Francois (SLAC)

Presenter: DRIELSMA, Francois (SLAC)

Session Classification: Day 2: Afternoon

Contribution ID: **11** Type: **not specified**

Clustering Cosmic Muon and Neutrino Interactions in MicroBooNE using a Deep Convolutional Neural Network

Friday, 19 June 2020 10:45 (15 minutes)

We have developed an incarnation of Mask-RCNN based on Facebook's 'Detectron' framework. Our implementation of this network, sMask-RCNN (Sparse Mask-RCNN), is trained to look at wire signal readout images from the MicroBooNE time projection chamber, and output a variable number of objects within the image. Each object is classified between either coming from a neutrino interaction, or a cosmic muon, given a bounding box, and an individual segmentation mask. sMask-RCNN has been modified from the original 'Detectron' structure to include a Sparse Convolution ResNet for speed. However in order to benefit from the feature-finding ability of pretrained versions of dense ResNet, we translate dense ResNet weights trained on ImageNet into our sparse version. While sMask-RCNN is designed for cosmic finding within the MicroBooNE detector, the network could be adjusted in the future to identify different interaction types and different detectors. The network may further be useful to other networks employed in MicroBooNE and Liquid Argon TPC (LArTPC) particle physics by providing a sparse ResNet trained to find interaction features. Code has been made available at: https://github.com/NuTufts/Detectron.pytorch

Primary author: MILLS, Joshua (MicroBooNE)

Presenter: MILLS, Joshua (MicroBooNE)

Session Classification: Day 2: Morning

Contribution ID: **12** Type: **not specified**

Using a Convolutional Neural Network to Reconstruct Dead Channels in MicroBooNE

Friday, 19 June 2020 11:00 (15 minutes)

LArTPCs (Liquid Argon Time Projection Chambers) are one of the most promising types of detector in beam neutrino physics. When a neutrino interacts in liquid argon, the resulting leptons ionize the argon atoms which emit electrons. An electric field in the detector causes the electrons to drift to a set of wire readout planes which convert the analog signal into a digital one. The resulting ADC values can be reconstructed into an image of wire vs. time values. Convolutional neural nets have been used in the field of deep learning to search for patterns in images and to alter images, so they can be applied to the result image from a LArTPC. One potential problem in LArTPCs is faulty wiring. If some of the wires are not reading out data properly, it can cause gaps in the images. This can make event reconstruction less effective. This talk presents the results for training a generative convolutional neural network that reconstructs the ADC values in simulated faulty channels for a LArTPC detector output.

Primary author: MASON, Katie (Tufts University)

Presenter: MASON, Katie (Tufts University)

Session Classification: Day 2: Morning

Contribution ID: **13** Type: **not specified**

Particle Clustering in LArTPCs with Embedding Learning Convolutional Neural Networks

Wednesday, 17 June 2020 14:15 (15 minutes)

In this poster, we present a fast and scalable deep learning algorithm for particle clustering in liquid argon time projection chamber (LArTPC) data, as part of the machine learning based reconstruction effort at SLAC. Particle clustering refers to the task of grouping image pixels into particle instances, which is regarded as one of the most challenging tasks in LArTPC data reconstruction. Building on previous works on sparse convolutional neural networks and proposal free instance segmentation, we build an end-to-end trainable particle clustering deep neural network that can learn an embedding of the image pixels to perform point cloud clustering in a transformed space. Using 3D images of LArTPC open dataset, we evaluate the network's purity and efficiency of cluster assignments and assess its overall computing resource usage. The proposed algorithm is applicable to data reconstruction of 2D and 3D imaging LArTPC detectors, including DUNE and SBN programs.

Primary author: KOH, Dae (SLAC)

Co-author: TERAO, Kazuhiro (SLAC)

Presenter: KOH, Dae (SLAC)

Session Classification: Day 1: Afternoon

Contribution ID: **14** Type: **not specified**

Learning from Data: the Zen of Deep Learning in KamLAND

Friday, 19 June 2020 11:15 (15 minutes)

Neutrinoless Double Beta Decay($0\nu\beta\beta$) is one of the major research interests in neutrino physics. The discovery of $0\nu\beta\beta$ would answer persistent puzzles in the standard model. KamLAND-Zen experiment is one of the leading efforts in the search of $0\nu\beta\beta$. The data is taken from 745kg of Xe136 isotopes using 1879 PMTs. Simultaneously, deep learning is a process of learning from data. Thus in this talk, I will present the knowledge and insight we learned from KamLAND-Zen data. I will show the path of self-developed machine learning event classification algorithm to increase sensitivity. Furthermore, we enhance the algorithm with spherical geometry of the detector. Eventually, we aim to design an independent analysis chain with the deep learning approach.

Primary author: LI, Aobo (Boston University)

Presenter: LI, Aobo (Boston University)

Session Classification: Day 2: Morning

Contribution ID: **15** Type: **not specified**

Detection of Cosmic Muon Spallation Background in LS-Detector Using Machine Learning

Wednesday, 17 June 2020 11:30 (15 minutes)

Neutrinos are the most abundant but also the most mysterious fermions in the universe. In rare event searches like those for neutrinoless double-beta decay ($0\nu\beta\beta$), one of major backgrounds is caused by cosmic muon spallation. To remove these background events, a precise method with high efficiency is required to separate them from signal events. Machine learning offers a solution to this problem. More specifically, for the spherical detector in KamLAND-Zen, convolutional neural networks (CNNs) based on a spherical system provides a way to classify the data. Besides the classification, a method related to regional CNNs is also developed, aiming to reconstruct the direction of particles in a detector. This poster will cover the concept and usage of spherical CNNs for KamLAND-Zen's data, and the current performance of the direction-determination for simulations.

Primary author: FU, Zhenghao (MIT)

Presenter: FU, Zhenghao (MIT)

Session Classification: Day 1: Morning

Contribution ID: **16** Type: **not specified**

1D CNN ROI finder

Modern neutrino experiments like the Deep Underground Neutrino Experiment will make use of Liquid Argon Time Projection Chamber (LArTPC) detectors that involve tens of thousands of readout channels. Reading out the raw wire waveforms from all these channels, especially for low-energy phenomena, can prove challenging in terms of the large data volumes. We describe a Machine Learning-based approach that uses lightweight 1D CNNs to discriminate signal-like from background-like waveforms. We also discuss our extension of this application from a simple classifier to a Region-Of-Interest (ROI) finder that can identify the location of the signal within the full waveform. I will present results that help quantify the performance of the method. This technique will be useful as a trigger or filter in data acquisition at the early stages of offline reconstruction

Primary author: UBOLDI, Lorenzo

Co-authors: Dr WANG, Micheal (Fermilab); Dr YANG, Tingjun (Fermilab)

Presenter: UBOLDI, Lorenzo

Session Classification: Day 2: Morning

Contribution ID: **17** Type: **not specified**

Reconstructing 10 GeV-Scale Neutrino Events in IceCube using CNNs

Wednesday, 17 June 2020 13:45 (15 minutes)

The IceCube Neutrino Observatory, which instruments a cubic kilometer of Antarctic ice, aims to detect astrophysical and atmospheric neutrinos. The detector contains 5160 photomultiplier tubes arranged in a 3D hexagonal array, which capture Cherenkov radiation emitted from the daughter particles of neutrino interactions. While IceCube detects astrophysical neutrinos in the TeV-PeV energy range, the more densely instrumented center, called DeepCore, is optimized to measure atmospheric neutrinos in the 10s of GeV energy scale. These energy ranges are important for measuring fundamental properties of neutrinos such as the oscillation parameters and searching for non-standard interactions, but current reconstruction methods for these events take seconds to minutes. A convolutional neural network has been implemented and optimized for 10s of GeV-scale events in DeepCore, to reconstruct neutrino energy and direction. This method takes milliseconds per event, which is orders of magnitude faster than previous methods, with the ultimate goal to additionally improve the resolution for low energy event reconstruction in IceCube.

Primary author: MICALLEF, Jessie (Michigan State University)

Presenter: MICALLEF, Jessie (Michigan State University)

Session Classification: Day 1: Afternoon

Contribution ID: **18** Type: **not specified**

Modeling Vector and Axial Nucleon Form Factors with Bayesian Neural Networks

Friday, 19 June 2020 10:30 (15 minutes)

The vector and axial form factors describe the electroweak structure of the nucleon. They are obtained from the analysis of the electron and neutrino scattering data.
Accurate predictions of the nucleon form factors are important for the proper modeling of the neutrino-nucleon and neutrino-nucleus cross-sections. I will review the Bayesian neural network approach, which allows us to obtain unbiased parametrization of the nucleon form factors. The idea of the approach is to use the adaptive abilities of the neural networks as well as Bayesian statistics philosophy. The 'best fit' is chosen from the ensemble of the neural network models ranked by the evidence (probabilistic measure). I will discuss the bias-variance trade-off dilemma (overfitting problem). The talk is based on the papers: Phys.Rev.C 99 (2019) 2, 025204; Phys.Rev.C 91 (2015) 4, 045205; J.Phys.G 42 (2015) 3, 034019; Phys.Rev.C 90 (2014) 054334; Phys.Rev.C 88 (2013) 065205; Phys.Rev.C 84 (2011) 034314; and JHEP 09 (2010) 053.

Primary author: Dr KRZYSZTOF, Graczyk (Institute of Theoretical Physics, Wroclaw University)

Presenter: Dr KRZYSZTOF, Graczyk (Institute of Theoretical Physics, Wroclaw University)

Session Classification: Day 2: Morning

Contribution ID: **19** Type: **not specified**

Using Sparse Convolutional Neural Networks in MicroBooNE

Wednesday, 17 June 2020 11:15 (15 minutes)

The MicroBooNE experiment employs a Liquid Argon Time Projection Chamber (LArTPC) detector to measure sub-GeV neutrino interactions from the muon neutrino beam produced by the Booster Neutrino Beamline at Fermilab. Neutrino oscillation measurements, such as those performed in MicroBooNE, rely on the capability to distinguish between different flavors of neutrino interactions. Deep Convolutional Neural Networks (CNNs) present high success for these tasks; however, due to the large sparsity of the data ($< 1\%$ pixels are non-zero), a naive approach of applying CNNs becomes highly inefficient in both computation time and memory resources. Recently Submanifold Sparse Convolutional Networks (SSCNs) have been proposed to address this challenge and have successfully applied to analyze large LArTPC images in MicroBooNE with orders of magnitude improvement in computing resource usage. In this poster, I will present the performance of SSCNs on the task of Semantic Segmentation applied in the analysis of simulated MicroBooNE data.

Primary author: ITAY, Ran (WEIZMANN INST.)

Presenter: ITAY, Ran (WEIZMANN INST.)

Session Classification: Day 1: Morning

Contribution ID: **20** Type: **not specified**

Development of a BDT-based multi-ring sample at the T2K far detector

Wednesday, 17 June 2020 10:45 (15 minutes)

The T2K experiment in Japan studies neutrino oscillations by measuring ν_e appearance and ν_μ disappearance from a ν_μ beam using a near and far detector. Super-Kamiokande (SK), a large water Cherenkov detector, acts as the far detector, where charged products of neutrino interactions on water are observed as rings of light. Neutrino oscillation analyses at T2K currently only use single-ring events at SK. A 2-ring ν_e CC1π^+ sample, where both an e-like ring and a π^+-like ring are produced, is currently being developed using boosted decision trees (BDTs) trained with reconstructed variables from fiTQun, a likelihood-based fitter. Although preliminary results are promising, the benefits of applying machine learning techniques to fiTQun variables are limited. These limitations may be exacerbated as the number of rings increases. This talk will discuss some of these limitations, exemplifying the need for improved event reconstruction using machine learning techniques.

Primary author: TOWSTEGO, Trevor (University of Toronto)

Presenter: TOWSTEGO, Trevor (University of Toronto)

Session Classification: Day 1: Morning

Contribution ID: **21** Type: **not specified**

Estimating prediction uncertainties for neutron tagging in Super-Kamiokande

Neutrino experiments (particularly Super-Kamiokande) rely on neutron tagging techniques in order to discriminate between neutrinos and antineutrinos. The use of traditional Machine Learning (ML) techniques in order to build data-driven neutron taggers is nowadays a well established procedure which show very good performance. In the language of ML, the idea is to build a classifier which is able to discriminate between neutron events and background events. However, the uncertainty associated with the predictions of such a tagger, which a priori could be sizeable, would affect its ability to classify an event as signal or background and therefore must be considered. In this work in progress, we are addressing this issue by working in a Bayesian approach, which provide a principled uncertainty estimation. Specifically we work with Bayesian Neural Networks together with Variational Inference methods in order to estimate the prediction uncertainties of a neutron tagger, trained with Super-Kamiokande high-energy simulation data. Note, however, that the method developed here will be applicable not only to the problem of neutron classifier, but essentially to any classifier, as neutral-current vs. charged-current interactions, among others.

Primary author: Dr ZALDÍVAR, Bryan

Presenter: Dr ZALDÍVAR, Bryan

Session Classification: Day 1: Morning

Contribution ID: **22** Type: **not specified**

Reconstructing 3D charge positions in LArTPCs using a CNN

Friday, 19 June 2020 13:00 (15 minutes)

MicroBooNE is a short baseline neutrino experiment at Fermilab aimed at measuring neutrino-argon cross-sections and probing for sterile neutrinos. The detector is a 85t Liquid Argon Time Projection Chamber (LArTPC) with three readout planes, each of which records charge depositions as 2D images of channel position versus time. We present a new deep learning method for reconstructing the 3D positions of charge depositions based on finding spatial correspondence between the three TPC readout plane images. Our method takes advantage of the sparsity of LArTPC by using a sparse convolutional neural network to extract features from the 2D images. Those are used to infer 3D position from geometrically allowed 2D charge triplets. We discuss the performance of this novel approach.

Primary author: SHARANKOVA, Ralitsa (Tufts University)

Presenter: SHARANKOVA, Ralitsa (Tufts University)

Session Classification: Day 2: Afternoon

Contribution ID: **23** Type: **not specified**

A Convolutional Neural Network for Shower Energy Reconstruction in MicroBooNE

Wednesday, 17 June 2020 13:00 (15 minutes)

The MicroBooNE experiment consists of a liquid argon time projection chamber (LArTPC) in which ionization electrons created by charged particles traversing the detector are collected by a set of three anode wire planes. The wire readout is combined with the drift time of the ionization electrons to reconstruct the 3D path of the charged particle. Electrons from neutrino interactions will create electromagnetic showers, which appear in the wire planes as a region of charge that must be identified by a "clustering" algorithm. Electron energy reconstruction methods in MicroBooNE currently rely on the combination of a clustering algorithm and a linear calibration between the shower energy and charge contained in the cluster. Recent effort has been made to improve this reconstruction process through the use of a convolutional neural network (CNN). This talk will cover the current status of the CNN method, including the network architecture and the performance on simulated data. The talk will also show initial comparisons between the CNN and the traditional clustering method. Finally, near-future directions for improving and validating the performance of the CNN will be discussed.

Primary author: KAMP, Nicholas

Presenter: KAMP, Nicholas

Session Classification: Day 1: Afternoon

Contribution ID: **24** Type: **not specified**

Machine Learning Applications for Reactor Antineutrino Detection at PROSPECT

Wednesday, 17 June 2020 13:15 (15 minutes)

PROSPECT is an antineutrino detector located above ground at the High-Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory (ORNL). The energy spectrum of antineutrinos emitted from the reactors is measured by using a delayed coincidence technique through the inverse-beta-decay reaction (IBD). The ORNL group is currently exploring several applications of machine learning techniques for the reconstruction and analysis of antineutrino events. In this talk, an overview of these efforts will be presented. Specifically, the use of the individual distribution of the observables of positron and neutron signals in IBD's can be used as input to train a neural network to discriminate between true IBD interactions and accidental correlations. Furthermore, we explore the possibility of using machine learning techniques to optimize the pulse-shape discrimination (PSD) variable that is used for particle classification.

Primary author: DELGADO, Andrea (Oak RIdge National Laboratory)

Presenter: DELGADO, Andrea (Oak RIdge National Laboratory)

Session Classification: Day 1: Afternoon

Contribution ID: **25** Type: **not specified**

Interaction Clustering in Liquid Argon Time Projection Chamber using Graph Neural Networks

Friday, 19 June 2020 13:45 (15 minutes)

Liquid Argon Time Projection Chamber (LArTPC) is a type of particle imaging detectors that can record an image of charged particle trajectories with high (~mm/pixel) spatial resolution and calorimetric information. LArTPC is widely used in accelerator-based neutrino oscillation experiments, including Short Baseline Neutrino (SBN) program and Deep Underground Neutrino Experiment (DUNE). The research team at SLAC leads the R&D of Machine Learning (ML) based full data reconstruction chain for LArTPCs, which aims at providing fully reconstructed event information that allows to infer the neutrino oscillation physics. In this poster, we present the multi-particle interaction clustering using Graph Neural Networks (GNNs) which can address the challenge of disambiguating individual neutrino interaction at the DUNE near detector where we expect more than a dozen "neutrino pile-up"per event.

Primary authors: LIN, Qing (SLAC); TERAO, Kazuhiro (SLAC); DRIELSMA, Francois (SLAC); Mr COTE DE SOUX, Pierre (Stanford University)

Presenter: LIN, Qing (SLAC)

Session Classification: Day 2: Afternoon

Contribution ID: **48** Type: **not specified**

Close out

Friday, 19 June 2020 14:15 (15 minutes)

Primary authors: AURISANO, Adam (University of Cincinnati); ADAMS, Corey (Argonne National Laboratory); Prof. BIAN, Jianming (University of California-Irvine); TERAO, Kazuhiro (SLAC); DEL TUTTO, Marco (Fermilab); PROUSE, Nick (TRIUMF); DE PERIO, Patrick (TRIUMF); WONGJIRAD, Taritree (Tufts University)

Presenters: AURISANO, Adam (University of Cincinnati); ADAMS, Corey (Argonne National Laboratory); Prof. BIAN, Jianming (University of California-Irvine); TERAO, Kazuhiro (SLAC); DEL TUTTO, Marco (Fermilab); PROUSE, Nick (TRIUMF); DE PERIO, Patrick (TRIUMF); WONGJIRAD, Taritree (Tufts University)

Session Classification: Day 2: Afternoon

Contribution ID: **49** Type: **not specified**

Introduction

Wednesday, 17 June 2020 10:30 (15 minutes)

Primary author: TERAO, Kazuhiro (SLAC)

Presenter: TERAO, Kazuhiro (SLAC)

Session Classification: Day 1: Morning

Contribution ID: **50** Type: **not specified**

Sparse Segmentation for Particle ID in ProtoDUNE

Friday, 19 June 2020 14:00 (15 minutes)

This talk presents the application of sparse convolutional neural networks in three dimensions in the ProtoDUNE Liquid Argon Time Projection Chamber (LArTPC) detector, building on previous applications of the technique in other LArTPCs. Sparse convolutions allow for computationally efficient processing of very large and high-resolution three-dimensional images, making them a natural fit for fine-grained particle detectors. The use of segmentation techniques allows for particle ID to be performed on individual 3D hits, without the need to produce higher-level objects. This poster will discuss input production and network architecture, present training and inference benchmarking on ProtoDUNE simulation, and describe techniques for defining ground truth using the underlying simulation. Particle identification accuracies are presented for a range of particle classes.

Primary author: S SARASTY SEGURA, Carlos (University of Cincinnati)

Presenter: S SARASTY SEGURA, Carlos (University of Cincinnati)

Session Classification: Day 2: Afternoon