I Workshop de Computing y Software de la Red Española de LHC

Wednesday, 28 April 2021 - Thursday, 29 April 2021

Book of Abstracts

Contents

COMCHA / 1

Hardware for Machine Learning and ML as a service

Corresponding Author: mdelamor@us.es

COMCHA / 2

Anomalies detection with Machine Learning at the LHC

Corresponding Author: judita.mamuzic@cern.ch

COMCHA / 3

Application of Machine Learning for LHC experiment operations

Author: Pablo Martinez Ruiz Del Arbol[1]

[1] *Universidad de Cantabria and CSIC (ES)*

Corresponding Author: pablo.martinez@cern.ch

COMCHA / 4

Topical presentations

COMCHA / 5

Future of COMCHA

Author: Arantza De Oyanguren Campos[1]

[1] *Univ. of Valencia and CSIC (ES)*

Corresponding Author: arantza.de.oyanguren.campos@cern.ch

LHC Computing / 6

Strategy and perspectives

Authors: Andreu Pacheco Pages[1]; Jose Hernandez[2]; Jose Salt[3]

[1] *Institut de Física d'Altes Energies - Barcelona (ES)*

[2] *CIEMAT*

[3] *Univ. of Valencia and CSIC (ES)*

Corresponding Authors: jose.salt@cern.ch, chema.hernandez.calama@gmail.com, pacheco@ifae.es

LHC Computing / 7

Short presentations

LHC Computing / 8

Resources and exploitation

Author: Santiago Gonzalez De La Hoz[1]

[1] *Univ. of Valencia and CSIC (ES)*

Corresponding Author: santiago.gonzalezdelahoz@cern.ch

LHC Computing / 9

Data Management

Corresponding Authors: chema.hernandez.calama@gmail.com, jose.flix.molina@cern.ch

LHC Computing / 10

Analysis Facilities

Author: Antonio Perez-Calero Yzquierdo[1]

Co-author: Andreu Pacheco Pages [2]

[1] *Centro de Investigaciones Energéti cas Medioambientales y Tecno*

[2] *Institut de Física d'Altes Energies - Barcelona (ES)*

Corresponding Authors: antonio.perez.calero.yzquierdo@cern.ch, pacheco@ifae.es

COMCHA / 11

Welcome

Author: Carmen Garcia[1]

[1] *Univ. of Valencia and CSIC (ES)*

Corresponding Author: carmen.garcia@cern.ch

LHC Computing / 12

Welcome and Introduction

Author: Jose Salt[1]

[1] *Univ. of Valencia and CSIC (ES)*

Corresponding Author: jose.salt@cern.ch

LHC Computing / 14

Test

This is a test

LHC Computing / 18

Lightweight site federation for CMS support

Authors: Carlos Acosta Silva[1]; Antonio Delgado Peris[2]; Jose Flix Molina[2]; Jaime Gómez del Pulgar Ruano[3]; Jose Miguel Guerrero[3]; Jose Hernandez[3]; Antonio Perez-Calero Yzquierdo[2]; Francisco Javie Rodriguez-Calonge[2]

[1] *PIC*

[2] *Centro de Investigaciones Energéti cas Medioambientales y Tecno*

[3] *CIEMAT*

Corresponding Author: antonio.delgado.peris@cern.ch

LHC Computing / 19

Exploitation of network-segregated CPU resources at BSC for CMS

Authors: Jose Hernandez[1]; Antonio Delgado Peris[2]; Antonio Perez-Calero Yzquierdo[2]; Jose Flix Molina[2]

[1] *CIEMAT*

[2] *Centro de Investigaciones Energéti cas Medioambientales y Tecno*

Corresponding Author: chema.hernandez.calama@gmail.com

COMCHA / 20

A Deep Learning approach to LHCb Calorimeter reconstruction using a Cellular Automaton

Author: Nuria Valls Canudas[1]

Co-authors: Xavier Vilasis Cardona [1]; Miriam Calvo Gomez [1]; Elisabet Golobardes Ribe [2]

[1] *La Salle, Ramon Llull University (ES)*

[2] *University of Barcelona (ES)*

The optimization of reconstruction algorithms has become a key aspect in LHCb as it is currently undergoing a major upgrade that will considerably increase the data processing rate. Aiming to accelerate the second most time consuming reconstruction process of the trigger, we propose an alternative reconstruction algorithm for the Electromagnetic Calorimeter of LHCb. Together with the use of deep learning techniques and the understanding of the current algorithm, our proposal decomposes the reconstruction process into small parts that benefit the generalized learning of small neural network architectures and simplifies the training dataset. This approach takes as input the full simulation data of the calorimeter and outputs a list of reconstructed clusters in a nearly constant time without any dependency in the event complexity.

LHC Computing / 21

ATLAS EventIndex: A Catalogue of all ATLAS Events

Authors: Carlos Garcia Montoro[1]; Alvaro Fernandez Casani[1]; Santiago Gonzalez De La Hoz[1]; Jose Salt[1]; Javier Sanchez[2]; Miguel Villaplana[1]

[1] *Univ. of Valencia and CSIC (ES)*

[2] *Universidad de Valencia (ES)*

Corresponding Author: carlos.garcia.montoro@cern.ch

COMCHA / 22

Hunting dark matter signals with deep learning at the LHC

Authors: Andres Daniel Perez[1]; Ernesto Arganda[2]; Anibal Medina[1]; Alejandro Szynkman[1]

[1] *IFLP - UNLP/CONICET*

[2] *Instituto de Física Teórica UAM/CSIC*

Corresponding Author: perez.andres.daniel@gmail.com

We study several simplified dark matter models and their signatures at the LHC using Neural Networks. We focus on the usual monojet plus missing transverse energy channel, but to train the algorithms we organize the data in 2D histograms instead of event-by-event arrays. This results in a huge performance boost to distinguish between standard model (SM) only and SM plus new physics signals. We found that Neural Network results do not change with the number of background events if they are shown as a function of $S/\sqrt{B}$, where S and B are the number of signal and background events per histogram, respectively. This provides flexibility to the method, since testing a particular model is straightforward, only the new physics monojet cross-section is needed. Furthermore, we also discuss the network performance under incorrect assumptions. Finally, we propose multimodel classifiers to search and identify new signals in a more general way, for the next LHC run.

COMCHA / 23

High-dimensional sampling algorithms comparison for particle and astrophysics applications

Authors: Roberto Ruiz De Austri[1]; Judita Mamuzic[2]

[1] *Instituto de Fisica Corpuscular (ES)*

[2] *IFIC Valencia*

High energy physics analyses often encounter optimization problems in high-dimensional parameter space, and finding an optimal algorithm represents an important initial step in each analysis, where typically an optimum of a very complicated function needs to be found. We performed an optimization algorithm comparison using a number of test functions, for increasing dimensionality, and compared them to a random sampling algorithm. Additionally we made a performance comparison for a realistic high dimensional example, derived from a recent global fit of weak-scale Supersymmetry. We find that for different test functions different algorithms show to be optimal, and we present comparison of performance for random sampling, Differential Evolution, Particle Swarm Optimization, the Covariance Matrix Adaptation Evolution Strategy, Bayesian Optimization, Grey Wolf Optimization, and the PyGMO Artificial Bee Colony, Gaussian Particle Filter and Adaptive Memory Programming for Global Optimization algorithms in [1].

[1] https://arxiv.org/abs/2101.04525

COMCHA / 24

Jet classification in t-tbar decays of heavy BSM resonances in ATLAS using ML techniques

Authors: Jorge Juan Martinez De Lejarza Samper[1]; Julio Lozano Bahilo[1]; Jose Salt[2]

[1] *Univ. of Valencia and CSIC (ES)*

[2] *Instituto de Fisica Corpuscular (IFIC) - Universidad de Valencia*

Corresponding Author: jormard2@alumni.uv.es

The search for heavy resonances with diverse mass and width values is the ultimate goal of the ATLAS physics group where we are developing this
study. The analysis selects events where one of the top quarks decays hadronically and the other one semileptonically. The reconstruction of the
different components of the decay allows us to build an invariant mass distribution which would show some excess around the mass of the resonance
if it exists.

The improvement in the reconstruction of the ttbar decay is the main purpose of our study. Therefore we are replacing a traditional Chi2 technique
based on intermediate invariant mass values and transverse momentum balance with a novel approach making use of Machine Learning algorithms with
any variable that might contribute to a classification of the jets of the event.

After a selection of appropriate events we store a set of variables for each jet in the event including kinematic variables, angular distances,
invariant masses and tagging variables. Our classification involves 4 different classes: b jet from hadronic decay; b jet from semileptonic decay;
jets coming from the desintegration of the W boson of the hadronic top quark decay and any other jet present in the event but not related to the
resonance decay process. Given the fact that we prefer to characterise the jets in a non-binary way,

our problem would be termed as multiclass
multilabel. We have used several algorithms capable of providing classification for that kind of problem, namely Deep Neural Networks, Random Forest
and eXtreme Gradient Boosting in order to train our dataset of jets.

As a first step we study the relevance of the variables with the help of the Permutation Importance method (DNN) and the Boruta method (RF, XGB)
and discard those that do not contribute to any algorithm and resonance mass. Then we proceed with the optimization of the hyperparameters for each
kind of algorithm. The training is followed by an assignment of jet roles within each event that gives our final reconstruction efficiency.

Preliminary results show a reconstruction efficiency at M(Z')=1TeV of around 77% of the events where all jets were matched (reference jets) at
Monte Carlo level for XGB and slightly smaller efficiencies for RF and DNN. The traditional Chi2 method gives values just above 70% for the same
mass value. Current work involves the addition of the Chi2 assignment to the set of variables and the use of a clustering algorithm to allow further
optimization of the ML classifying algorithms.

LHC Computing / 25

A Spanish data cache service for the CMS experiment

Author: Jose Flix Molina[1]

Co-authors: Jose Hernandez [2]; Antonio Perez-Calero Yzquierdo [1]; Carlos Acosta Silva [3]; Antonio Delgado [4]; Carlos Perez Dengra [5]

[1] *Centro de Investigaciones Energéti cas Medioambientales y Tecno*

[2] *CIEMAT*

[3] *PIC*

[4] *University of Notre Dame (US)*

[5] *PIC-CIEMAT*

Corresponding Author: jose.flix.molina@cern.ch

COMCHA / 26

DNN used in the search for scalar top quark pair production in the top corridor region

Author: Andrea Trapote Fernandez[1]

[1] *Universidad de Oviedo (ES)*

Corresponding Author: andrea.trapote.fernandez@cern.ch

A parametric DNN algorithm is used to separate signal from background in the search for scalar top quark pair production at the LHC. This search targets a region of parameter space where the kinematics of top squark pair production and top quark pair production are very similar, because of the mass difference between the top squark and the neutralino being close to the top quark mass. The search is performed with the full run 2 data set of proton-proton collisions at a centre-of-mass energy of 13 TeV, collected by the CMS detector.

COMCHA / 27

Information

Corresponding Authors: jose.salt@cern.ch, chema.hernandez.calama@gmail.com, pacheco@ifae.es, luca.fiorini@cern.ch