Abstract Submitted
for the 4CS20 Meeting of
The American Physical Society

Machine Learning based LLRF control system for superconducting cavities[1] JORGE DIAZ CRUZ[2], REZA PIRAYESH[3], SANDRA BIEDRON[4], SALVADOR SOSA[5], MANEL MARTINEZ-RAMON[6], University of New Mexico — Producing more than 1450 peer reviewed scientific publications, the Linac Coherent Light Source (LCLS) is the first hard X-ray electron laser in the world. Due to its success, an upgrade to the facility, LCLS-II, was proposed and it is now under commissioning. One of the main upgrades is the use of superconducting cavities. LCLS-II will use 9-cell 1.3 GHz superconducting cavities. Due to the high quality factor and low beam charge, detuning of the cavities is a major issue for energy efficiency of the machine. The Low-Level Radio-Frequency (LLRF) control system and the resonance control system are in charge of providing a stable RF field to the cavities while keeping the resonance frequency of the cavities close to the nominal 1.3 GHz. In parallel to the LCLS-II developments, Machine Learning (ML) an Artificial Intelligence (AI) are tools that engineers and scientists are now using and exploring in the accelerator community. From image and data processing of colliders and FELs, to fault detection and control system tuning of subsystems of accelerators, ML and AI are showing better results than traditional techniques and are therefore promising in other subsystems. In this research, we present preliminary results of a LLRF control system based on a Neural Network (NN) using simulated data for the training, validation and test. We use the Theta supercomputer at the Argonne Leadership Computing Facility to produce the data and train the NN.

[1]This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of High Energy Physics, under award number DE-SC0019468. This work was performed under Contract No. DE-AC02-76SF00515 supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences

[2]Department of Electrical and Computer Engineering
[3]Department of Mechanical Engineering
[4]Department of Electrical and Computer Engineering
[5]Department of Electrical and Computer Engineering
[6]Department of Electrical and Computer Engineering

Jorge Diaz Cruz
University of New Mexico

Date submitted: 28 Sep 2020 Electronic form version 1.4