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# Artificial Intelligences for measuring energy deposits in the ATLAS LAr calorimeter in real time

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Within the Phase-II upgrade of the LHC, the readout electronics of the ATLAS Liquid Argon (LAr) Calorimeters is prepared for high luminosity operation expecting a pile-up of up to 200 simultaneous pp interactions.

The Liquid Argon (LAr) calorimeters measure the energy of particles produced by LHC collisions, especially electrons and photons. The digitized signals from the LAr 182468 channels are analysed in real time, at 40 MHz, by high-end Field Programmable Gate Array (FPGA) to provide a detailed map of energy deposits from up to 200 simultaneous collisions (pile-up). In order to maintain high precision event reconstruction at HL-LHC in these challenging conditions, the LAr readout electronics and its embarked algorithms are to be improved.

The growing processing power of FPGAs and many advances in Artificial Intelligence systems provide cutting-edge opportunities. We have developed new algorithms for real time energy deposit measurements based on Recurrent Neural Networks (RNN). These algorithms are compared to the conventional algorithms based on Optimal Filtering using realistic simulation of single LAr channels.

We demonstrate that RNNs, especially those based on Long Short-Term Memory (LSTM), outperform current algorithms, even with limited parameter counts. Furthermore, RNNs offer possibilities to improve the resilience of the fundamental LAr measurements against pile-up and proton beam conditions. The latest results of these studies are also presented.

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