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Artificial Neural Networks on FPGAs for Real-Time Energy Reconstruction of the ATLAS LAr Calorimeters

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Within the Phase-II upgrade of the LHC, the readout electronics of the ATLAS LAr Calorimeters is prepared for high luminosity operation expecting a pile-up of up to 200 simultaneous pp interactions. Moreover, the calorimeter signals of up to 25 subsequent collisions are overlapping, which increases the difficulty of energy reconstruction. Real-time processing of digitized pulses sampled at 40 MHz is thus performed using FPGAs.

To cope with the signal pile-up, new machine learning approaches are explored: convolutional and recurrent neural networks outperform the optimal signal filter currently used, both in assignment of the reconstructed energy to the correct bunch crossing and in energy resolution.

Very good agreement between neural network implementations in FPGA and software based calculations is observed. The FPGA resource usage, the latency and the operation frequency are analysed. Latest performance results and experience with prototype implementations will be reported.

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