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Machine Learning-Based Energy Reconstruction for the ATLAS Tile Calorimeter at HL-LHC

The HL-LHC project is driving significant upgrades to the ATLAS experiment to enhance data processing and maintain its discovery potential under high-luminosity conditions. A key aspect of this upgrade is the replacement of the readout electronics for the ATLAS Tile Hadronic Calorimeter. The new Tile PreProcessor (TilePPr) system, equipped with Kintex Ultrascale FPGAs, serves as the interface between the front-end electronics and the first level of the future ATLAS Trigger system. The TilePPr will perform real-time signal reconstruction, delivering calibrated data for each bunch crossing at 40 MHz with a fixed and low-latency path. This contribution will focus on the design, implementation, and performance evaluation of Machine Learning-based reconstruction algorithms within the TilePPr, designed to meet the HL-LHC requirements. Different neural network architectures are being explored to achieve accurate and efficient energy reconstruction while keeping computational and storage demands low. Given the constraints of real-time processing, special emphasis is placed on model optimization strategies, ensuring fast inference on FPGAs without loss of precision.

AI keywords

Estimation, Machine Learning, FPGA, Neural Network

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