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NeuralRinger: An Ensemble of Neural Networks Fed from Calorimeter Ring Sums for Triggering on Electrons

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In 2017, the ATLAS experiment implemented an ensemble of neural networks (NeuralRinger algorithm) dedicated to reduce the latency of the first, fast, online software (HLT) selection stage for electrons with transverse energy above 15 GeV. In order to minimize detector response and shower development fluctuations, and being inspired in the ensemble of likelihood models currently operating in the offline and final HLT selections, the ensemble comprises Multi-Layer Perceptron (MLP) models tuned for pseudo-rapidity and transverse energy bins. The MLPs are fed from calorimetry information formatted into concentric ring energy sums, which are built around the particle axis and normalized by its total transverse energy. Although triggering algorithms are typically developed from offline models adapted to operate in stringent online conditions, the NeuralRinger development was starting from the online perspective. We describe the analysis performed during the NeuralRinger development in the Run 2, the trigger commissioning and its online performance during the 2017 and 2018 data-taking. It is estimated that the Neural Ringer allowed a reduction of 25% in the e/γ slice processing demands when considering its operation on top of all other improvements done in the electron chains. Statistical tests performed on crucial offline calorimeter response discriminant features show negligible impact ($<1\sigma$) in offline reconstruction.

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