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Model-Independent Real-Time Anomaly Detection at CMS with CICADA

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In the search for new physics, real-time detection of anomalous events is critical for maximizing the discovery potential of the LHC. CICADA (Calorimeter Image Convolutional Anomaly Detection Algorithm) is a novel CMS trigger algorithm operating at the 40 MHz collision rate. By leveraging unsupervised deep learning techniques, CICADA aims to enable physics-model independent trigger decisions, enhancing sensitivity to unanticipated signals. One of the key challenges is deploying such a system on resource-constrained hardware without compromising performance. This is addressed by utilizing knowledge distillation to replicate performance of larger unsupervised anomaly detection models in smaller supervised models that maintain high detection sensitivity while significantly reducing the memory footprint and computational demands. The final compressed model is deployed on FPGAs, allowing CICADA to perform real-time decision-making while operating within the stringent constraints of the CMS trigger system during Run3 data taking. In this talk, we will detail the architecture of CICADA, describe the knowledge distillation process, and evaluate its performance.

Focus areas

HEP

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