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Rings of Light, Speed of AI: YOLO for Cherenkov Reconstruction

Cherenkov rings play a crucial role in identifying charged particles in high-energy physics (HEP) experiments. The size of the light cone depends directly on the mass and momentum of the particle that produced it. Most Cherenkov ring pattern reconstruction algorithms currently used in HEP experiments rely on a likelihood fit to the photo-detector response, which often consumes a significant portion of the computing budget for event reconstruction. As the field moves toward real-time event reconstruction, faster and more efficient techniques are needed.

We present a novel approach to Cherenkov ring reconstruction using YOLO, a computer vision algorithm capable of real-time object identification with a single pass through a neural network. The pipeline is trained on a simulated dataset containing approximately 60 Cherenkov rings per event, with significant overlaps on the detector plane. The performance meets the requirements of modern HEP experiments, achieving a reconstruction efficiency above 95% and a pion misidentification rate below 5% across a wide momentum range for all particle species.

AI keywords

object detection; attention; computer vision; YOLO; edgeML

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