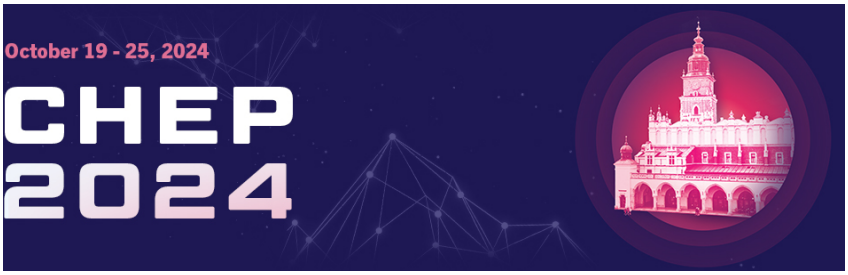

Contribution ID: **3** Type: **Talk**

HPCNeuroNet: A Neuromorphic Approach Merging SNN Temporal Dynamics with Transformer Attention for FPGA-based Particle Physics

Thursday 24 October 2024 16:33 (18 minutes)

This paper presents the innovative HPCNeuroNet model, a pioneering fusion of Spiking Neural Networks (SNNs), Transformers, and high-performance computing tailored for particle physics, particularly in particle identification from detector responses. Drawing from the intrinsic temporal dynamics of SNNs and the robust attention mechanisms of Transformers, our approach capitalizes on these synergies to achieve heightened performance in discerning intricate particle interactions. At the heart of HPCNeuroNet lies the integration of the sequential dynamism inherent in SNNs with the context-aware attention capabilities of Transformers, enabling the model to precisely decode and interpret complex detector data. HPCNeuroNet is realized through the HLS4ML framework, optimized for deployment on FPGA environments. This architectural choice not only enhances computing speed but also enhances the accuracy and scalability of the models. Benchmarked against traditional particle physics models, HPCNeuroNet showcases superior performance metrics, underlining its transformative potential in high-energy physics. Our findings illuminate the groundbreaking potential of conjoining SNNs, Transformers, and FPGA-based high-performance computing in the domain of particle physics, marking a significant stride forward and establishing a robust foundation for future endeavors in the field.

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