EUROPEAN AI FOR FUNDAMENTAL PHYSICS CONFERENCE EuCAIFCon 2024

Contribution ID: **103** Type: **Flashtalk with Poster**

Adaptive Machine Learning on FPGAs: Bridging Simulated and Real-World Data in High-Energy Physics

Tuesday, 30 April 2024 14:28 (3 minutes)

In the realm of high-energy physics, the advent of machine learning has revolutionized data analysis, especially in managing the vast volumes of data produced by particle detectors.
Facing the challenge of analyzing unlabelled, high-volume detector data, advanced machine learning solutions become indispensable.
Our research introduces a machine learning approach that effectively bridges the gap between simulated training data and real-world detector data.
Anchored in domain adaptation principles, our technique uniquely leverages both simulated data (with known signal/background distinctions) and real-world data, thereby enhancing model accuracy and applicability.
Central to our methodology is the use of a low-memory, high-performance stochastic binary neural network.
This network is specifically designed for implementation on Field-Programmable Gate Arrays (FPGAs), which offers the dual advantages of high-speed data processing and adaptability, essential for real-time physics data analysis.
Our results not only demonstrate the theoretical robustness of our model but also its practical efficacy, highlighted by significant improvements in accuracy and throughput in a high-energy physics case study – Flavours of Physics: Finding $\tau \to \mu\mu\mu$ [1].
The FPGA implementation underscores our model's potential in delivering real-time, efficient data processing solutions in physics research, paving the way for new advancements in the field.

[1} kaggle. Flavours of Physics: Finding $\tau \to \mu\mu\mu$. https://www.kaggle.com/c/flavours-of-physics/overview

Primary authors: KÖPPEL, Marius (ETH Zürich); Dr CERRATO, Mattia (Johannes Gutenberg Universität, Mainz)

Presenter: KÖPPEL, Marius (ETH Zürich)

Session Classification: 1.4 Hardware acceleration & FPGAs

Track Classification: Session A