Contribution ID: **133** Type: **Lightning 5 min talk + poster**

Robust and interpretable deep learning by leveraging domain knowledge

Tuesday 15 October 2024 15:15 (5 minutes)

Recently, compelling evidence for the emission of high-energy neutrinos from our host Galaxy - the Milky Way - was reported by IceCube, a neutrino detector instrumenting a cubic kilometer of glacial ice at the South Pole. This breakthrough observation is enabled by advances in AI, including a physics-driven deep learning method capable of exploiting available symmetries and domain knowledge. This reconstruction method combines deep learning with maximum-likelihood estimation.
Analogously to Monte Carlo simulations, the neural network architecture is defined in forward direction, which allows for the decoupling of physics and detector effects and thus direct incorporation of domain knowledge in the network architecture. Due to the exploitation of this prior knowledge, the required amount of training data is reduced, and training convergence is facilitated. The resulting model can robustly extrapolate along built-in symmetries, while retaining beneficial properties of maximum-likelihood estimation such as uncertainty quantification and explainability. The presented hybrid reconstruction method is therefore well suited for applications in simulation-based domains that require a high standard of interpretability and robustness.

Focus areas

MMA

Author: HÜNNEFELD, Mirco (University of Wisconsin-Madison)

Presenter: HÜNNEFELD, Mirco (University of Wisconsin-Madison)

Session Classification: Lighting talks