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Bayesian Neural Network applied to Cherenkov event reconstruction

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The domain of low energy neutrinos is at the edge of making important measurements, among which the Diffuse Supernova Neutrino Background and the Upturn of the electron flavor survival probability of solar neutrinos. In this context, the next generation of Cherenkov detectors will need algorithms that outperform traditional regression algorithms to reconstruct both low and high energy charged particle events. Key challengers for this task are Neural Networks, as they have become increasingly more performant and reliable during the last decade, and their use for physics regression and classification tasks have proved their worth regarding the possible gain of precision, accuracy and computation time.
This work will present the current status of a machine learning (ML) model based on Graph Neural Networks aiming at predicting relevant variables of low energy charged particle events in Cherenkov detectors, such as the vertex of interaction and the particle's energy. In particular, a Bayesian Neural Network based on stochastic variational inference is considered. The advantages of this type of Neural Network will be presented, most notably its ability to probe the uncertainties of the model's weight and biases, which is an important improvement over other ML models. The performance of our model will then be showed using Monte-Carlo simulations of future Cherenkov detectors such as Hyper-Kamiokande (HK), Water Cherenkov Test Experiment (WCTE) and Intermediate Water Cherenkov Detector (IWCD).

Poster prize

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