

Reconstruction of Neutrino Events in IceCube using Graph Neural Networks [PoS(ICRC2021)1044]

Martin Ha Minh for the IceCube collaboration
martin.haminh@icecube.wisc.edu
Technical University Munich

What is this contribution about?

A fast and flexible reconstruction algorithm for low-energy neutrino events in IceCube and IceCube Upgrade using Graph Neural Networks

Why is this relevant / interesting?

Current reconstruction methods are slow and suboptimally equipped for future extensions, such as the IceCube Upgrade. Alternative new approaches might be limited by information transformation or reduction. This approach circumvents these issues.

What have we done?

We developed a method to use Graph Neural Networks for event reconstruction and classification that is completely non-specific to the detector configuration. To show this, we reconstructed simulated events for our current detector and compared them to the baseline algorithm. We also applied the GNN algorithm to simulated data of the IceCube Upgrade, for which no mature reconstruction algorithm exists yet.

What is the result?

We show that the GNN algorithm outperforms the resolution of the baseline algorithm in all reconstructed parameters, i.e. neutrino energy, zenith angle of the arrival direction, and interaction type (track vs. cascade). We also show a dramatic speed increase on the order of 10^4 . We also show that the algorithm is fully usable for the reconstruction of IceCube Upgrade events and quantify the improvement the hardware extension introduces.