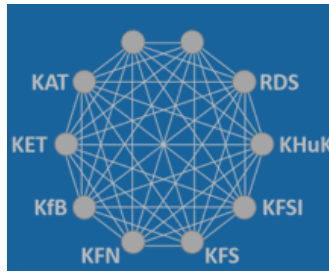


ErUM-Data Community Information Exchange



Contribution ID: 30

Type: **not specified**

Advanced On- and Off-line reconstruction methods in Neutrino Astronomy

Wednesday, 1 January 2025 09:55 (5 minutes)

The IceCube Neutrino Observatory measures cosmic neutrinos by detecting Cherenkov-light from neutrino interactions using optical sensors embedded in the Antarctic Ice. Main challenge is related to the sparseness of locally complex information and the systematic uncertainties related to the propagation of optical photons through the natural ice medium and its properties. Machine-learning techniques have already been applied very successfully to IceCube and my interest is focused on two unsolved questions that seem ideally suited for ML applications.

1.) Inclusion of systematic uncertainties for real-time alerts that are sent to the astrophysical community. Critical is the proper estimation of the event-direction uncertainty. Currently, alerts do not include systematic uncertainties. Those vary with the individual event topology and can only be estimated by a computational intense analysis. Goal is a better estimation of uncertainty predictions by DNNs.

2.) Reconstruction for next generation multiple PMT sensors.

Next generation instruments will consist of optical sensors with multiple photomultipliers integrated into a single sensor unit providing a fly's-eye type of local light measurements. Traditional Likelihood approaches have so far failed in benefiting from the full information. Goal of this project is developing a new reconstruction that is A) extracting relevant features from the single sensor images. B) improved track reconstruction by combing these features.

List of Committees:

KAT, KET

Please describe your expertise/areas in which you would like to contribute / advise.

Application of multivariate ML methods and DNN to event reconstruction and data selection in Big data applications. Good experience in CNN and GNN in several projects combined with GPU computing.

Do you consent to the data usage and public abstract data posting in the ErUM-Data Community Information Exchange?

Yes

In ErUM-Data, what kind of data are you dealing with?

Large data sets of events, recorded by optical sensors in Neutrino telescopes. Raw data are time-resolved wave-forms of individual sensors.

What is your expertise in computing and / or software development?

Long year experienced in Big data processing, event reconstruction and likelihood analyses

What is your field and role?

University professor in experimental physics, astroparticle and neutrino physics.

Your ErUM - Committee is

More than one

Please describe areas in which you can contribute to “data handling” teaching.

Application examples integrated in lecture exercises

My current most burning research question, I like to find partners for, is:

- 1.) Including systematic uncertainties in reconstruction estimates
- 2.) Combining complex raw sensor data with high-level event reconstruction tasks

Please describe areas in which you would like to improve your knowledge / skills.

De/Encoding, GNN, multi-dimensional input data.

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