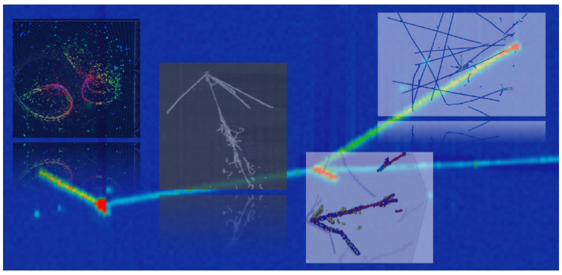

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Implicit Neural Representation as a Differentiable Surrogate for Photon Propagation in a Monolithic Neutrino Detector

Wednesday, 23 August 2023 13:45 (25 minutes)

Modern neutrino experiments employ hundreds to tens of thousands of photon detectors to detect scintillation photons produced from the energy deposition of charged particles. A traditional approach of modeling individual photon propagation as a look-up table requires high computational resources, and therefore it is not scalable for future experiments with multi-kiloton target volume.

We propose a new approach using SIREN, an implicit neural representation with periodic activation functions, to model the look-up table as a 3D scene. It reproduces the acceptance map with high accuracy using orders of magnitude less number of parameters than the look-up table. As a continuous and differentiable parameterization, SIREN also represents a smooth gradient surface. As such, it allows downstream applications such as inverse problem-solving and gradient-based optimizations. We demonstrate a data-driven method to optimize the SIREN model and an application of reconstruction using data collected from the Deep Underground Neutrino Experiment's (DUNE) near detector prototype.

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