

“A Frequentist Framework for Neural Simulation-Based Inference in Particle Physics ”

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Abstract

Particle physics is at the cusp of a paradigm shift in the treatment of experimental data for the measurement of theory parameters. While the field has traditionally relied upon histograms of fixed observables to summarise high dimensional data from the detector, this can compromise the sensitivity of the measurement. We develop a type of Neural Simulation-Based Inference (NSBI) method that can directly handle high-dimensional unbinned data for near optimal sensitivity. While the concept of NSBI has long been known to hold enormous potential, there have remained longstanding roadblocks to their application, such as the questions related to uncertainty quantification in the context of frequentist statistics in particle physics. In this talk, I will demonstrate the power of NSBI over histogram-based analyses for the measurement of a crucial Higgs properties at the Large Hadron Collider (LHC), discuss the challenges of systematic uncertainties and how to overcome them, and conclude with comments on the wide-scale impact of these new innovations on experimental particle physics well beyond the LHC.

Biography

Dr. Aishik Ghosh is a postdoctoral scholar at UC Irvine and Berkeley National Lab where he develops novel machine learning and computational methods for particle physics and astrophysics, and enjoys converting his proofs-of-concepts to deployed products in an experiment. He earned his Ph.D. from University of Paris-Saclay where he developed and deployed the first deep generative models for fast calorimeter simulation in the ATLAS experiment. Since then he has worked on topics of uncertainty quantification and uncertainty mitigation, and generative models for physics simulation and instrument design. Dr. Ghosh has fostered interdisciplinary collaborations within academia and with industry. He has contributed to a book on Artificial Intelligence for High Energy Physics and organises ML training schools for graduate students. Dr. Ghosh consults on AI policy with international organisations like the Organisation for Economic Co-operation and Development (OECD), with whom he has published writings on Trustworthy AI and AI for Science, and has given interviews to organisations like The Royal Society, UK.