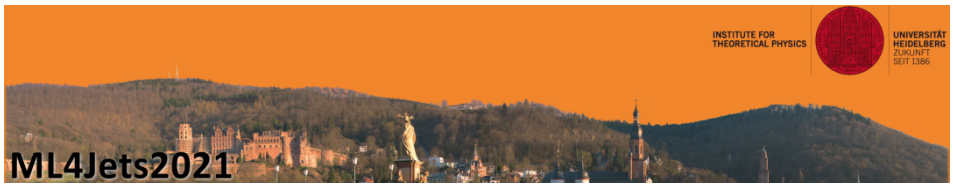

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Emerging techniques for sampling, searching, and summing over the combinatorially large space of shower histories

Tuesday, July 6, 2021 3:40 PM (20 minutes)

A central challenge in jet physics is that the evolution of the jet is an unobserved, latent process. In a semi-classical parton shower, this corresponds to a sequence of 1-to-2 splittings that form a tree-like showering history. Framing jet physics in probabilistic terms is attractive as it provides a principled framework to think about tasks as diverse as clustering, classification, parton shower tuning, matrix element —parton shower matching, and event generation of jets in complex, signal-like regions of phase space. Unfortunately, this usually involves either marginalizing (summing) or maximizing (searching) over the enormous space of clustering histories, which is typically intractable. We review three recently published works that address these challenges by building on techniques from statistics, machine learning, and combinatorial optimization. Each of these works are enabled by Ginkgo, a simplified, generative model for jets, designed to facilitate research in this area. We show how probabilistic programming can be used to efficiently sample the showering process, how a novel trellis algorithm can be used to efficiently marginalize over the enormous number of showering histories for the same observed particles, and how dynamic programming, A* search, and reinforcement learning can be used to find the maximum likelihood clustering in this enormous search space. (edited)

Affiliation

New York University

Academic Rank

postdoc

Authors: MACALUSO, Sebastian (New York University); BREHMER, Johann (NYU); PAPPADOPULO, Duccio (EPFL); CRANMER, Kyle Stuart (New York University (US)); DRNEVICH, Matthew (New York University (US))

Presenter: MACALUSO, Sebastian (New York University)

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