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OmniFoldHI: Advanced ML Unfolding for Heavy-Ion Data

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To compare collider experiments, measured data must be corrected for detector distortions through a process known as unfolding. As measurements become more sophisticated, the need for higher-dimensional unfolding increases, but traditional techniques have limitations. To address this, machine learning-based unfolding methods were recently introduced. In this work, we introduce OmniFoldHI, an improved version of the well-known algorithm [1], tailored for heavy-ion analyses. OmniFoldHI incorporates background counts, detector acceptances, efficiency, and uncertainties for real-analysis applications, and it works for an arbitrary number of observables. Besides removing detector effects, we demonstrate that unfolding can be used to subtract the underlying event, which is crucial for jet-quenching analyses and phenomenology. With these enhancements, OmniFoldHI functions effectively even without additional background subtraction. To illustrate its capabilities, we apply OmniFoldHI to unfold up to a 5-dimensional jet-substructure observable, comparing it to traditional techniques and quantifying uncertainties. We present model-independent results, with training and testing performed using different event generators. We show that OmniFoldHI reproduces the maximum likelihood estimate and provide mathematical proof of the ML unfolding algorithm.

[1] Andreassen et. al, Phys. Rev. Lett. 124, 182001 (2020)

Category

Theory

Collaboration

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