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Pidrix: Particle Identification Matrix Factorization

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Probabilistically identifying particles and extracting particle yields are fundamentally important tasks required in a wide range of nuclear and high energy physics analyses. Quantities such as ionization energy loss, time of flight, and Čerenkov angle can be measured in order to help distinguish between different particle species, but distinguishing becomes difficult when there is no clear separation between the measurements for each type of particle. The standard approach in this situation is to model the measurement distributions in some way and then perform fits to the recorded data in order to extract yields and constrain the model parameters. This carries the risk that even very small disagreements between the model and the true distributions can result in significant biases in both the extracted yields and their estimated uncertainties. We propose a new approach to particle identification that does not require the modeling of measurement distributions. It instead relies on the independence of measurement errors between different detectors to pose the problem as one of matrix factorization which is then solved using iterative update equations. This allows for the unsupervised determination of both the measurement distribution and yield of each particle species.

Summary

An unsupervised learning technique for particle identification, called pidrix, is introduced.

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