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Gibbs sampler for background discrimination in particle physics

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Background properties in experimental particle physics are typically estimated from large collections of events. This usually provides precise knowledge of average background distributions, but inevitably hides fluctuations. To overcome this limitation, an approach based on statistical mixture model decomposition is presented. Events are treated as heterogeneous populations comprising particles originating from different processes, and individual particles are mapped to a process of interest on a probabilistic basis. When used to discriminate against background, the proposed technique based on the Gibbs sampler allows some features of the background distributions to be estimated directly from the data without training on high-statistics samples. A feasibility study on Monte Carlo is presented, together with a comparison with existing techniques. Finally, the prospects for the development of the Gibbs sampler into a tool for intensive offline analysis of interesting events at the Large Hadron Collider are discussed.

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