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Interpolation between multi-dimensional histograms using a new non-linear moment morphing method

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In particle physics experiments data analyses generally use Monte Carlo (MC) simulation templates to interpret the observed data. These simulated samples may depend on one or multiple model parameters, such as a shifting mass parameter, and a set of such samples may be required to scan over the various parameter values. Since detailed detector MC simulation can be time-consuming, there is often a need to interpolate between the limited number of available MC simulation templates. Only several interpolation techniques exist for this. For example, the statistical tests widely used in particle physics, e.g. for the discovery of Higgs boson, rely critically on continuous and smooth parametric models that describe the physics processes in the data.

We present a new template morphing technique, moment morphing, for the interpolation between multi-dimensional distribution templates based on one or multiple model parameters. Moment morphing is fast, numerically stable, and is not restricted in the number of input templates, the number of model parameters or the number of input observables. For the first time, statistical tests may include the impact of a non-factorizable response between different model parameters, where varying one model parameter at a time is insufficient to capture the full response function.

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