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# Advanced techniques for Simulation Based Inference in collider physics

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We present an application of Simulation-Based Inference (SBI) in collider physics, aiming to constrain anomalous interactions beyond the Standard Model (SM). This is achieved by leveraging Neural Networks to learn otherwise intractable likelihood ratios. We explore methods to incorporate the underlying physics structure into the likelihood estimation process. Specifically, we compare two approaches: morphing-aware likelihood estimation and derivative learning. Furthermore, we illustrate how uncertainty-aware networks can be employed to compare the performance of these methods. Additionally, we demonstrate two new techniques for enhancing the accuracy and reliability of the network training. First, we introduce of a new way to treat the outliers in the target reconstruction-level distributions by repeated smearing and modifying their parton-level weights accordingly (dubbed fractional smearing). Second, we utilise Lorentz-equivariant network architectures to exploit the symmetry structure inherent in the underlying particle physics amplitudes.

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