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Does Lorentz-symmetric design boost network performance in jet physics?

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In the deep learning era, improving the neural network performance in jet physics is a rewarding task as it directly contributes to more accurate physics measurements at the LHC. Recent research has proposed various network designs in consideration of the full Lorentz symmetry, but its benefit is still not systematically asserted, given that there remain many successful networks without taking it into account. We conduct a detailed study on the Lorentz-symmetric design. We propose two generalized approaches for modifying a network - these methods are experimented on PFN, ParticleNet, and LorentzNet, and exhibit a general performance gain. We also reveal for the first time that the underlying reason behind the known improvement the "pairwise mass" feature brings to the network is that it introduces a structure that adheres to full Lorentz symmetry. We confirm that Lorentz-symmetry preservation serves as a strong inductive bias of jet physics, hence calling for attention to such general recipes in future network designs.

This talk is based on https://arxiv.org/abs/2208.07814 and includes new relevant studies.

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