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Modeling particle production in pp collisions with deep neural networks

During the data-taking campaigns Run 1 and Run 2, the ALICE collaboration recorded a large amount of proton-proton (pp) collisions across a variety of center-of-mass energies ($\sqrt{s}$). This extensive dataset is well suited to study the energy dependence of particle production. Deep neural networks (DNNs) provide a powerful regression tool to capture underlying multidimensional correlations inherent in the data. DNNs are used to parametrize recent ALICE measurements of multiplicity (N_{ch})- and transverse momentum (p_{T})-dependent charged-particle spectra. For this purpose, a Bayesian Optimization strategy is used to tune the model architecture based on PYTHIA simulations, maximizing the $\sqrt{s}$ extrapolation performance. The DNN systematic uncertainties are estimated by combining two different ensemble methods. This new approach allows extrapolating the ALICE measurements towards unmeasured collision energies, providing data-driven pp references for future heavy-ion measurements. In addition, a DNN-based particle composition study is developed to predict N_{ch}-dependent p_{T} spectra of different charged particle species ($\pi^{\pm}$, $\mathrm{K}^{\pm}$, $\mathrm{p}/\bar{\mathrm{p}}$, $^{\pm}$/-$^{\mp}$) with unprecedented granularity for arbitrary energies.

In this contribution, we present the current status of the analysis. We discuss the potential and limitations of using DNNs to model complex multidimensional data.

Would you like to be considered for an oral presentation?

Yes

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