



Contribution ID: 132

Type: Oral

## Particle Transformer for Jet Tagging

*Monday 24 October 2022 17:20 (20 minutes)*

Jet tagging is a critical yet challenging classification task in particle physics. While deep learning has transformed jet tagging and significantly improved performance, the lack of a large-scale public dataset impedes further enhancement. In this work, we present JetClass, a new comprehensive dataset for jet tagging. The JetClass dataset consists of 100 M jets, about two orders of magnitude larger than existing public datasets. A total of 10 types of jets are simulated, including several types unexplored for tagging so far. Based on the large dataset, we propose a new Transformer-based architecture for jet tagging, called Particle Transformer (ParT). By incorporating pairwise particle interactions in the attention mechanism, ParT achieves higher tagging performance than a plain Transformer and surpasses the previous state-of-the-art, ParticleNet, by a large margin. The pre-trained ParT models, once fine-tuned, also substantially enhance the performance on two widely adopted jet tagging benchmarks.

<https://arxiv.org/abs/2202.03772>

### Significance

Jet tagging is a widely adopted analysis technique in high energy physics experiment. In this work, we propose a large and comprehensive public dataset, JetClass. We also propose a transformer based machine learning model for jet tagging, Particle Transformer (ParT). Leveraging novel architect and special pairwise particle interaction information, ParT achieves state-of-the-art performance in jet tagging. Moreover, powered by the comprehensiveness and largeness, model pre-trained with JetClass performed better after fine-tuning with downstream tasks compared with the directly trained ones.

### References

<https://icml.cc/virtual/2022/poster/17989>

<https://indico.cern.ch/event/1144064/abstracts/144880/>

<https://indico.cern.ch/event/1078970/timetable/?view=standard#29-particle-transformer-for-je>

### Experiment context, if any

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**Session Classification:** Track 2: Data Analysis - Algorithms and Tools

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