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Linearized Optimal Transport for Jet Physics

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As an unsupervised machine learning strategy, optimal transport (OT) has been applied to jet physics for the computation of distance between collider events. Here we generalize the Energy Mover's Distance to include both the balanced Wasserstein-2 (W2) distance and the unbalanced Hellinger-Kantorovich (HK) distance. Whereas the W2 distance only allows for mass to be transported, the HK distance allows mass to be transported, created and destroyed, therefore naturally incorporating the total pt difference of the jets. Both distances enjoy a weak Riemannian structure and thus admit linear approximation. Such a linear framework significantly reduces the computational cost and in addition provides a Euclidean embedding amenable to simple machine learning algorithms and visualization techniques downstream. Here we demonstrate the benefit of this linear approach for jet classification and study its behavior in the presence of pileup.

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