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PELICAN: Equivariance and Explainability in Jet ML

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Despite the recent proliferation of symmetry-based machine learning methods in jet physics, the preference for smaller symmetry groups and highly custom architectures negatively impacts explainability and generalizability. In this work, we present an update to our own algorithm, which delivers both significant improvements in the top-tagging performance and the capability to perform full four-vector-regression. PELICAN is a fully Lorentz equivariant network which acts on input four-vectors in a permutation equivariant manner. The incorporation of these symmetries yields a network with unique explainability features and visualization capabilities. We investigate the generalizability of our network with respect to jet mass regression tasks in the context of Lorentz-boosted decays of top quarks and W bosons, performance in infrared and collinear safe regimes, and other frame-dependent detector effects. Finally, we propose an interpretation of PELICAN as a soft clustering algorithm and its potential use for Lorentz-invariant latent representations of jets.

Primary authors: BOGATSKIY, Alexander (Flatiron Institute); MILLER, David (University of Chicago); OFFERMANN, Jan (University of Chicago); HOFFMAN, Timothy (University of Chicago)

Presenters: OFFERMANN, Jan (University of Chicago); HOFFMAN, Timothy (University of Chicago)

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