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Exploring end-to-end image-based deep learning for particle & event classification

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An essential part of new physics searches at the Large Hadron Collider at CERN involves event classification, or distinguishing signal decays from one of its many background look-alikes. Traditional techniques have relied on reconstructed particle candidates and their physical attributes. However, such reconstructed data are the result of a long, potentially lossy process of forcing the raw sensor data into progressively more physically intuitive quantities. Meanwhile, powerful image-based machine learning algorithms have emerged that are able to directly digest raw sensory data and output a prediction—so called end-to-end deep learning classifiers. We explore the use of such algorithms to perform physics classification using raw sensory data from the CMS detector. As proof of concept, we classify photon- versus electron-induced ECAL showers and compare the performance of using raw sensor data versus shower shape data.

Primary author: ANDREWS, Michael (Carnegie Mellon University)

Co-authors: PAULINI, Manfred (Carnegie Mellon University); GLEYZER, Sergei (University of Florida)

Presenter: ANDREWS, Michael (Carnegie Mellon University)

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