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A readily-interpretable fully-convolutional autoencoder-like algorithm for unlabelled waveform analysis

Friday 23 October 2020 12:00 (5 minutes)

Waveform analysis is a crucial first step in the data processing pipeline for any particle physics experiment. Its accuracy, therefore, can limit the overall analysis performance although waveform analyses often face a variety of challenges, for example: overlapping 'pile-up'pulses, noise, non-linearities, floating baselines. Historically, many experiments have viewed template fitting as the optimal way to recover information about the underlying impulses. Here we demonstrate the connection between convolutional methods and template fitting, and adapt these approaches to overcoming typical challenges of waveform analysis.
Having set this foundation, we develop these concepts into a fully-convolutional autoencoder-like algorithm, capable of learning from unlabelled data. Being fully-convolutional this algorithm is capable of handling arbitrary length waveforms, but consequently the encoded space aims not for the dimensionality reduction of a typical autoencoder but rather sparsity in its activation. Moreover, being based on the fundamental understanding developed in the first part of the talk, this model is highly constrained, with each internal convolutional layer offering a straightforward interpretation. We finalise this talk with comparisons of the performance of this algorithm and more traditional approaches under several scenarios and consider some future potential directions.

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