Deep Convolutional Neural Networks for Long Time Series Classification

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Plasmas exhibit phenomena over a wide range of time and spatial scale. Often, plasma physicists apply a range of transforms or filters to extract features of interest (e.g. Fourier transforms, correlation analysis, peak detection, etc.). Neural networks have shown promise in learning the filters needed to accomplish a particular task, such as classifying whether an image has a car, without the need for humans specifying the transforms or filters. Several neural network architectures, such as recurrent neural networks (RNNs) and their variants such as LSTMs, have also proven very useful for sequence learning, including in time series. However, it is often difficult for such architectures to be trained on long time sequences, which invariably many plasma experiments have due to ever increasing data acquisition rates. Here we will discuss recent advances in deep convolutional neural networks for sequence learning, which allow for covering long time sequences, in order to be sensitive to the multiple time scales present. These will be applied to time series data from tokamak diagnostics, to show their utility.