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low magnitude seismic events using Convolutional Neural Networks

Detection of arrivals at seismic stations in a network is the first step in building seismic events. Improving the ability to accurately identify seismic arrivals for three-component stations in adverse signal-to-noise environments is vital to improving detection and location of seismic events. Waveform correlation and other template matching methods are modern techniques that may be used, yet, each have limitations. They lack compatibility between stations, require significant data, and accumulate large template databases, reducing performance. In this work, we present updated results using convolutional neural networks (CNNs). CNNs have been shown to significantly improve performance at local distances under conditions such as induced seismicity. We expand the use of CNNs to more remote distances and lower magnitudes. We explore the tradeoffs of certain architectures of CNN and update previous results. We describe performance results of our method tuned on a new dataset with expert defined picks. The dataset used is from the Dynamic Network Experiment 2018 (DNE18) and comes from sensors in Utah. We demonstrate the ability to train the CNN on these events and achieve significantly higher test set performance than standard methods. Furthermore, we validate performance on streaming data, including very low magnitude expert picked arrivals.

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