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Real time Earthquake detection using Deep Learning

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Seismic event detection and its magnitude estimation are the two crucial steps in real-time earthquake monitoring and early warning systems. Traditional EEW systems can be limited in their ability to accurately detect the arrival phases (P and S waves) and locate earthquakes, particularly for events with high levels of background noise. Deep learning has emerged as a promising alternative to traditional EEW algorithms, since these algorithms can automatically learn complex patterns and features in seismic data, allowing them to more accurately detect the seismic phase arrival times in the signals. In this study, we first propose a deep learning based architecture DynaPicker which uses a dynamic convolutional neural network to detect seismic body wave phases. Then, the pre-trained model is used to pick the seismic phases on the continuous seismic recording. This model is further combined with another deep-learning model CREIME to perform magnitude estimation. The experimental results on several open-source seismic datasets demonstrate that DynaPicker achieved a higher testing accuracy in seismic phase identification compared to other benchmark models. Additionally, DynaPicker's robustness in classifying seismic phases was tested on the low-magnitude seismic data polluted by noise. DynaPicker can be adapted to handle input data of varying lengths, making it well-suited for P/S phase picking. When applied to continuous seismic data, DynaPicker can identify more seismic events accurately and produce lower arrival time picking errors than baseline methods. We also found that using the estimated P-phase arrival time of DynaPicker, the CREIME model shows reliable results in estimating the magnitude of the aftershocks of the Turkey earthquake.