Seismic Event Detection from Volcanic Regions using Feature Extraction and Deep Learning
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Background and Motivation

❖ Manual identification of the arrival times of P and S waves from seismometer data offers great precision but involves human bias and effort
❖ Deep-learning models can effectively automate this process, but they do not incorporate scientific knowledge, nor do they offer any understanding of the classification process
❖ By pre-processing the data into scientifically meaningful features and using them as input to deep-learning models, we hypothesize improved performance and understanding

Why Wavelet?

❖ Seismic events like earthquakes possess characteristic temporal signatures
❖ Templates [1] have been used to capture these signatures.
❖ Wavelets [2] are a good way to operationalize this for the purposes of feature engineering for ML methods.

What a wavelet transform does!

The effect of this preprocessing step is not only to remove noise, but also more clearly expose the behavior of interest.

Details: One year of seismic data from the southern Taupo Volcanic Zone, New Zealand collected using a short-period seismometer with three component sensor aligned to North. Split into training and testing sets in a 70:30 ratio.

Results

❖ Model with featurized input exhibits better performance in terms of precision and proximity to the analyst-picked arrival times.
❖ Model with raw input is able to detect similar number of events but with lesser precision.

Future Work

❖ Explore more feature engineering mechanisms for the seismic waves such as continuous wavelet transform, fingerprints.
❖ Explore a neural network model that can retain memory such as Long Short Term Memory (LSTM).
❖ Build a model with the ability to classify the various kinds of earthquake events such as tremor and low-frequency earthquakes.


Scan the QR for more details!