Earthquake Monitoring in Artificial Intelligence Era

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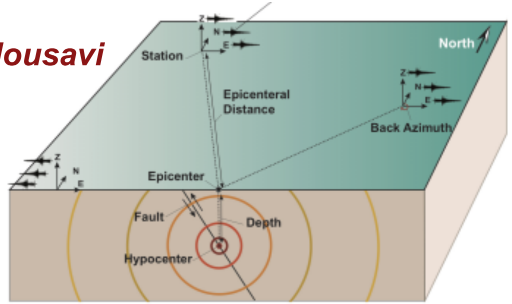
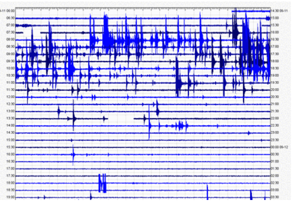
Abstract

Diverse algorithms have been developed for efficient earthquake signal processing and characterization. These algorithms are becoming increasingly important as seismologists strive to extract as much insight as possible from exponentially increasing volumes of continuous seismic data. Deep neural networks have been shown to be promising tools for this. We have developed a number of deep learning tools for more efficient processing and characterizing of earthquake signals. In my presentation, I demonstrate the performance of some of these tools applied to seismic data. AI-based techniques have the potential to improve our monitoring ability and as a result understanding of earthquake processes and hazards.

Earthquake Monitoring in Artificial Intelligence Era, *Mostafa Mousavi*



Recorded Ground Motions



Denoising
Mousavi and Langston (2016), BSSA
Mousavi and Langston (2017), Geophysics
Zhu et al (2019), IEEE-TGRS.

Detection
Mousavi et. al., (2016), SEG
Mousavi et al. (2018), Sci. Rep.
Mousavi et al. (2020), Nat. Commun.

Discrimination
Mousavi et al. (2016), GJI.
Mousavi et al. (2019), IEEE-GRSL.

Phase Picking
Mousavi et. al., (2016), Geophysics
Zhu and Beroza, (2019), GJI
Mousavi et al. (2020), Nat. Commun.

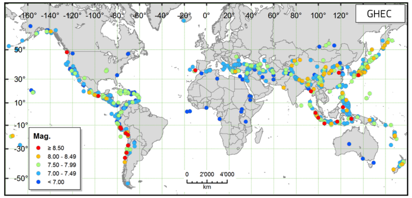
Polarity Determination
Mousavi et al. (2019), IEEE-GRSL.

Phase Association

Earthquake Location
Mousavi and Beroza (2020), IEEE-TGRS.

Magnitude Estimation
Mousavi and Beroza (2020), GRL

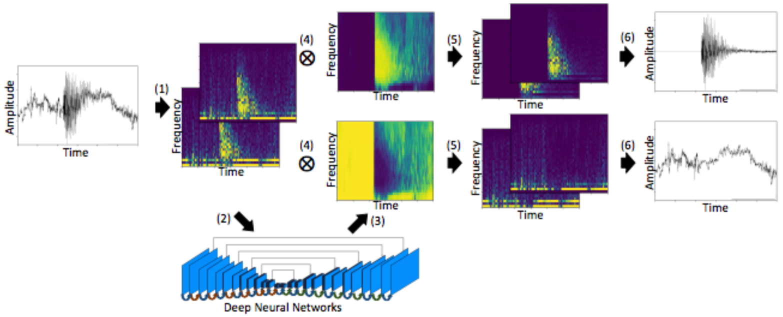
Earthquake Catalog



mmousavi@stanford.edu

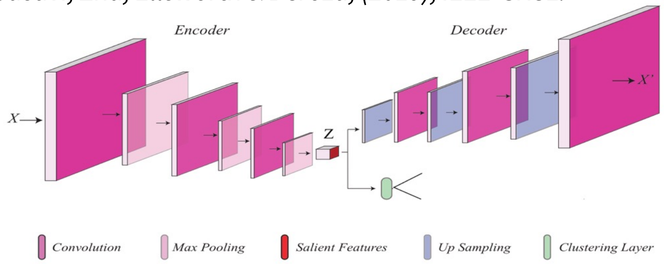
Dnoising (DeepDenoiser)

Zhu, Mousavi, & Beroza, (2018), IEEE-TGRS.



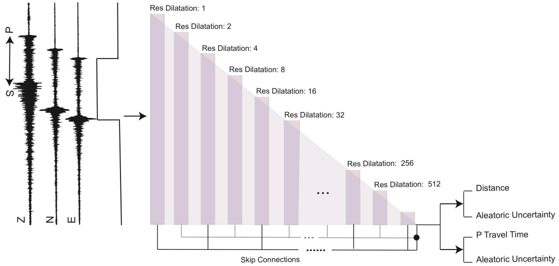
Event Discrimination & Polarity Determination

Mousavi, Zhu, Ellsworth & Beroza, (2019), IEEE-GRSL.



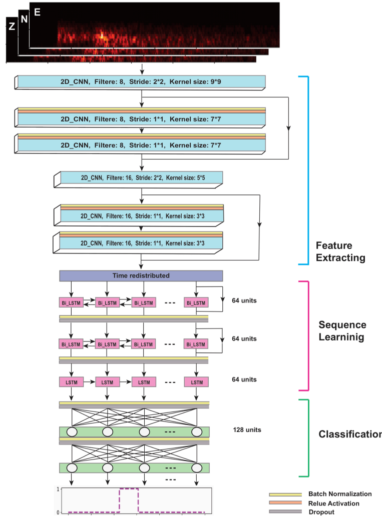
Single-Station Location

Mousavi & Beroza, (2020), IEEE-TGRS.



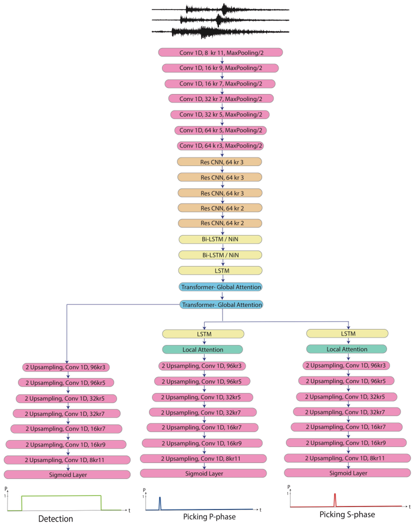
Detection (CRED)

Mousavi, Zhu, Sheng & Beroza, (2018), Scientific Report



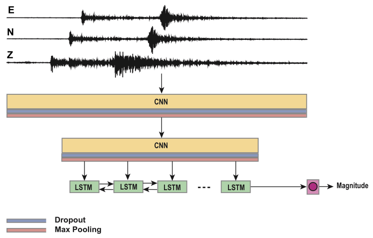
Detection & Picking (EQTransformer)

Mousavi et al, (2020), Nature Communication



Magnitude Estimation (MagNet)

Mousavi & Beroza, (2019), GRL.

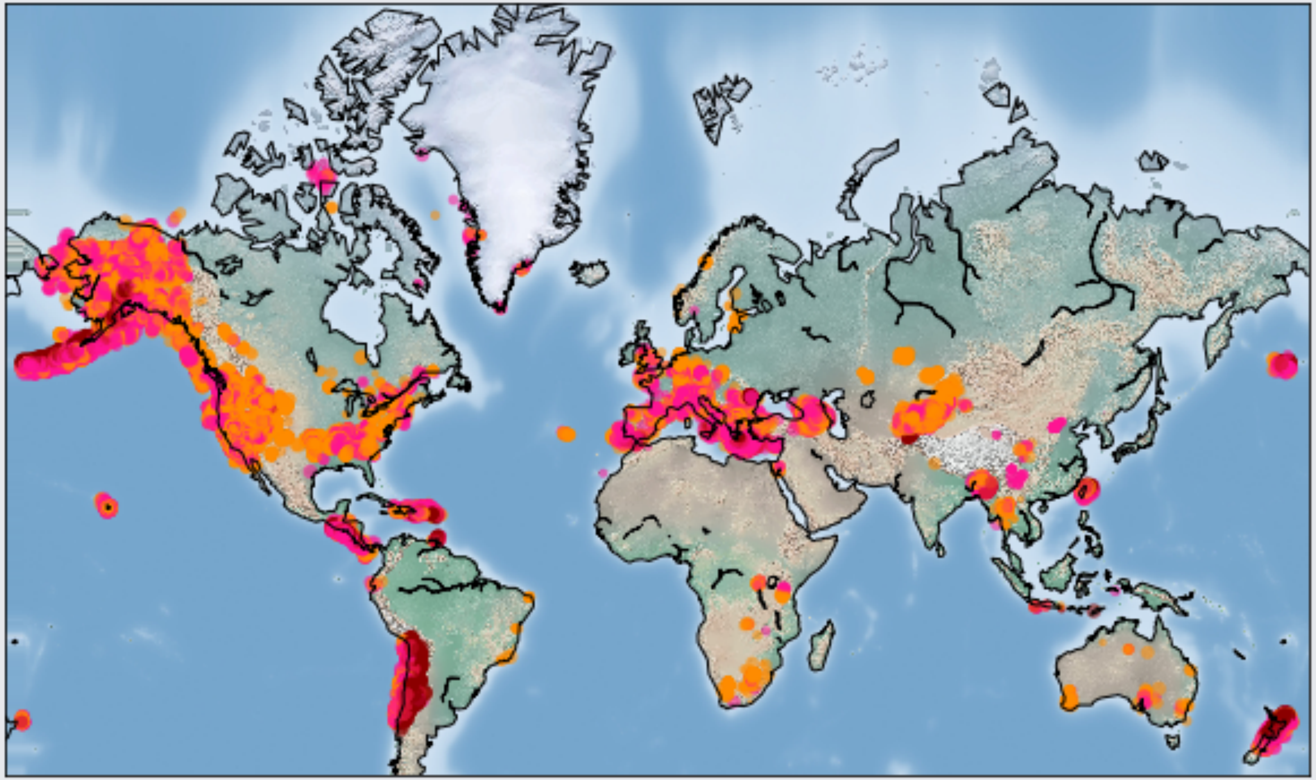


Stanford | Geophysics

STanford EArthquake Dataset (STEAD)

Mousavi et al, (2019), IEEE-Access.

1.3 M Labeled Waveform. **450 k** Earthquakes. **19,000** Hours of Data. **2613** Stations.



Depth
- Depth <= 10 km
- 10 < Depth <= 50 km
- 50 < Depth <= 100 km
- 100 < Depth

GitHub

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