MATCHING SEISMIC ACTIVITY WITH ITS SOURCE USING MACHINE LEARNING METHODS

EGU **Sharing Geoscience Online** 2020

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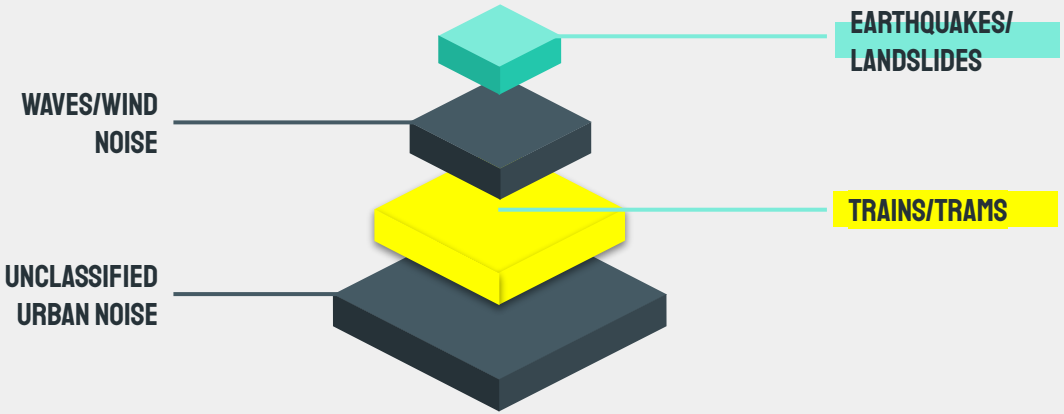
THE IDEA

Content of an urban seismic record



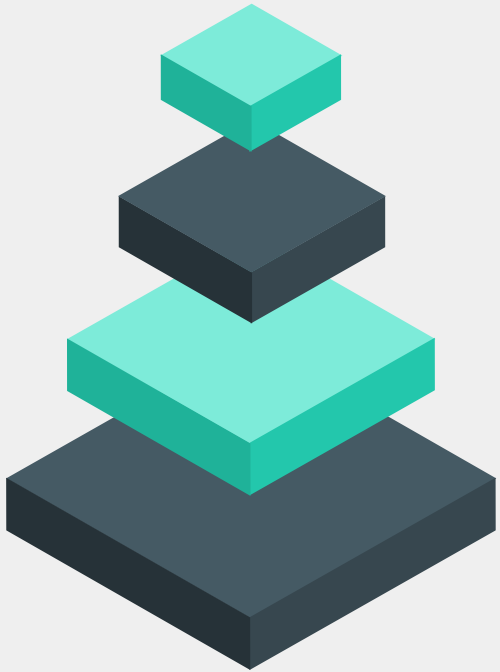
Detecting seismic signals and attributing them to their origin is necessary if one wants to understand the most frequent patterns in the environment. In earthquake seismology, a good signal to noise ratio (S/N) is often a prerequisite to listen to these very distant sources.

The seismic station of our study is located in an urban environment, surrounded by several train lines. Our seismic record are usually made up of a combination of different sources.

If we can make use of a deep learning model to automatically classify the incoming signals and differentiate between train lines, it might help us later in understanding and deploying it for more complicated tasks.

PROJECT GOALS

- The goal of the study is to match the seismic signals with the train schedule from the local public transport provider Wiener Linien
- This database can then be used to train a convolutional neural network, and make predictions in unseen signals
- subsequently, the type and the direction of the sources should be determined
- we want to quantify the amount of train signals in our data
- If this can be attributed, what and how much is then left unexplained?
- Lastly, the trained classifier can be tested on a second nearby station



WHY STUDY TRAINS?

EASY TARGET

The seismic station in our study shows very repetitive patterns which can be accurately attributed to the schedule from the nearby trains. Solving the classification task can therefore be verified and help to reduce the amount of “seismic noise”.

NEW TOOLS

The developed tools might be useful, when they come into action in a different environment. For example it could be used for rock fall or landslide detection

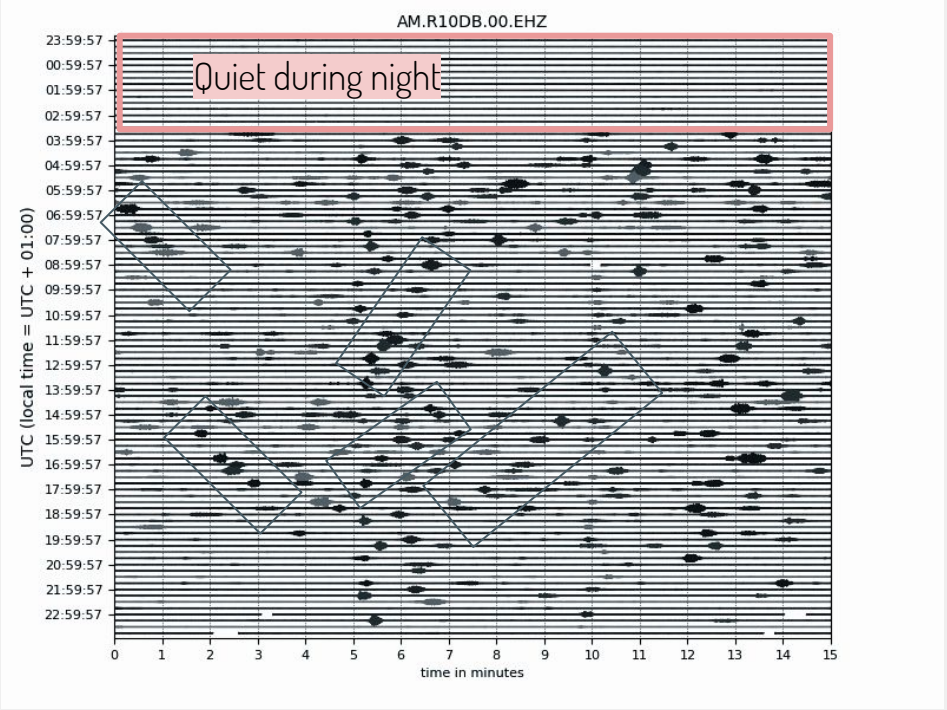
IMPROVE S/N

Studying seismic signals is only as good as their Signal to Noise ratio. Being able to attribute some of that “noise” to trains increases this ratio.

LOW MAGNITUDE EVENT DETECTION

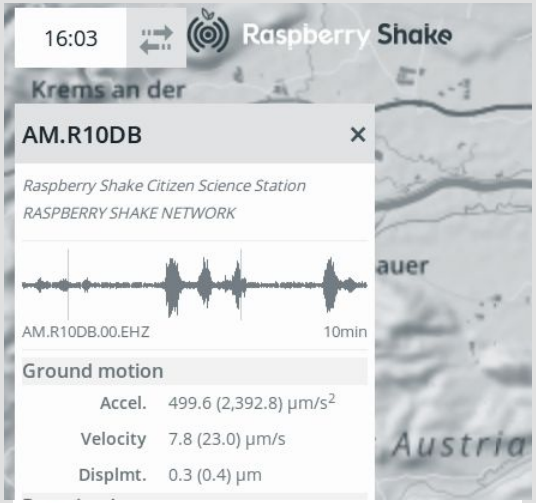
Better understanding of the environment might make it possible to find events which would otherwise have been buried underneath a more energetic signal

REGULAR SCHEDULE



This is how a day of our example seismic station (Raspberry Shake R10DB) looks like. The helicorder plot shows the regular patterns during the day..

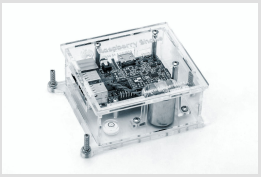
You can also visit the station live at:
https://raspberryshake.net/stationview/#?net=AM&sta=R10DB



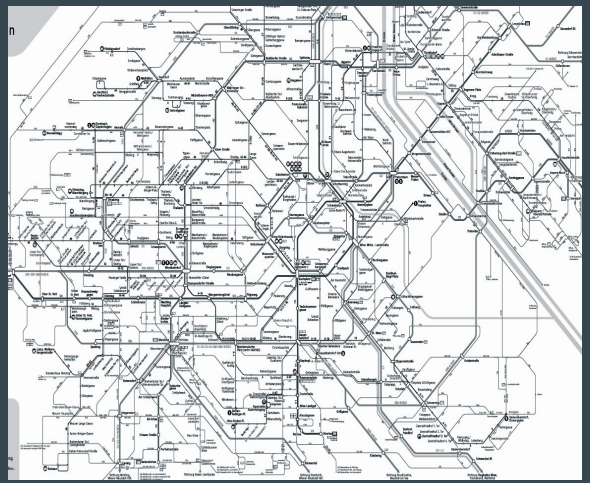
Access to seismic data from the Raspberry Shake network, as well as public transport information from Wiener Linien allows to build a labeled data set.

Real-Time Open Data

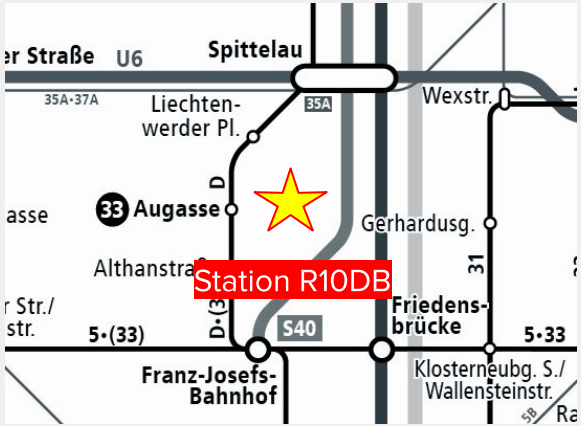
Raspberry Shake



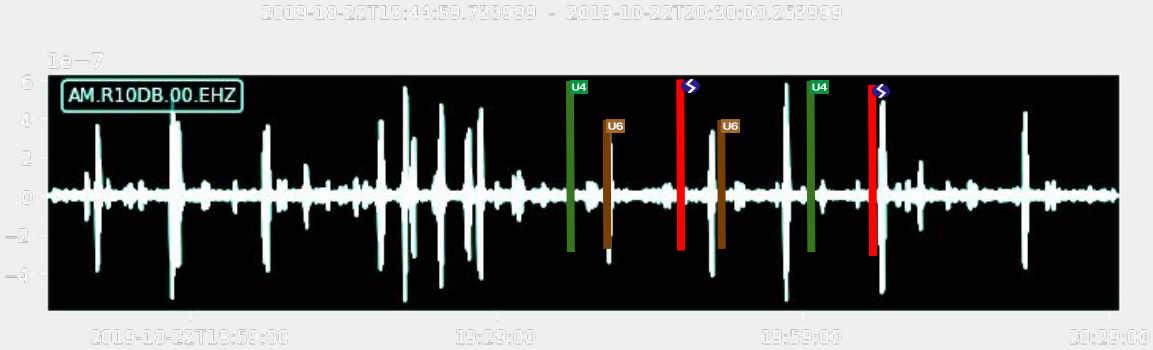
WIENER LINIEN



SET UP



The station is located at the IMGW (Institute of Meteorology and Geophysics) at the University of Vienna, surrounded by several train and tram lines. The signals can be automatically extracted and matched with the schedule from the passing trains.



This is how it could look like, when the classifier is working.

PROJECT STAGES

STAGE I - JUST STARTED

build database for classification

STAGE 2

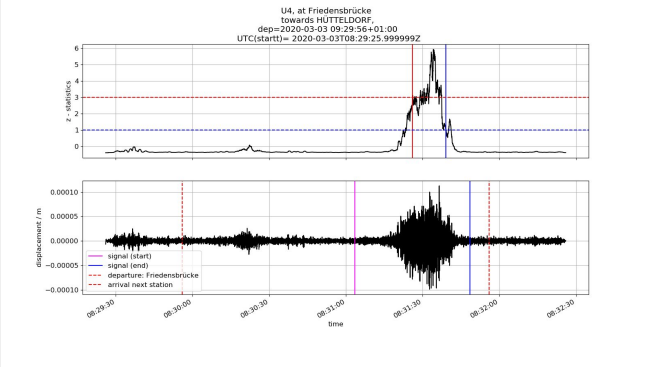
deploy ML model determine accuracy and find the best at this task

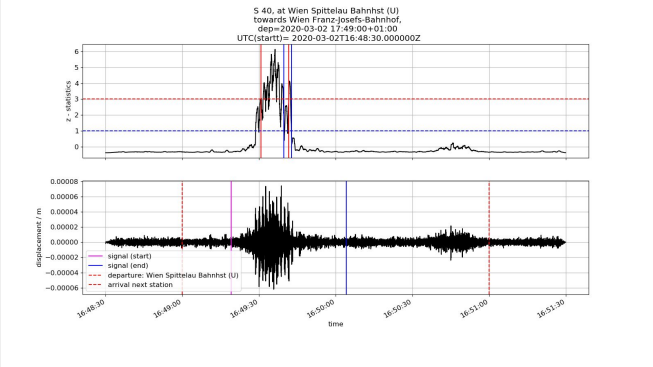
STAGE 3

try classification on different station

CURRENT RESULTS

The previous slides shall have outlined the idea of this project. Due to delays, the project has only just begun and will be continued in the future..





The extraction and matching of good and reliable waveforms is still in progress..

THANKS

For questions are remarks feel free to reach out:
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