GFZ

Natural Hazards and Risks in a Changing World

Helmholtz-Zentrum
POTSDAM

Volcanic tremor analysis based on advanced signal processing concepts including music information retrieval (MIR) strategies

Zahra Zali

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Outline

- Volcanic seismology- Volcanic tremors

- Methodology; music processing tools

- PhD Project prospect

- Examples

Volcanic seismology

Volcanic seismology represents the main, and often the only, tool to forecast volcanic eruptions and to monitor the eruption process.

A seismogram of volcanic earthquakes in an active period gives the general impression of the different types of the seismic signals associated with volcano-tectonic earthquakes, explosions, rock falls, or tremor.

Volcanic tremor is often used in conjunction with earthquake swarms as a geophysical warning that an eruption is not far off since it is often the direct result of magma forcing its way up toward the surface.
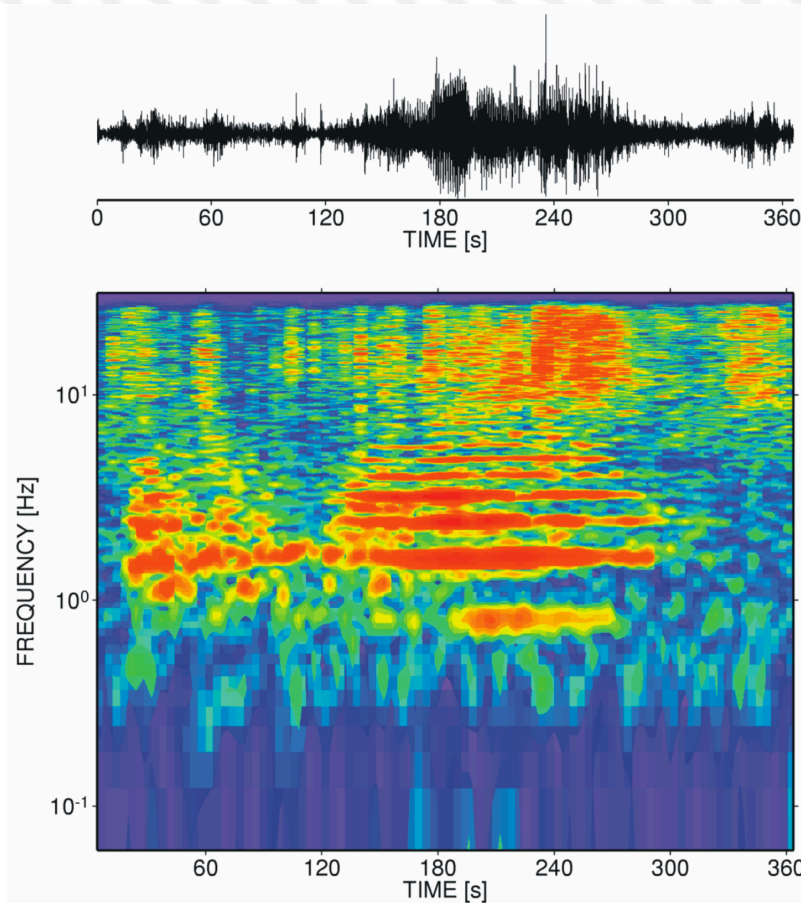
What is Volcanic Tremor

➢ Volcanic tremor, a type of continuous, rhythmic ground shaking different from the discrete sharp jolts characteristic of earthquakes.

➢ Such continuous ground vibrations, commonly associated with eruptions, are interpreted to reflect subsurface movement of fluids, either gas or magma.

What is Volcanic Tremor

Harmonic tremor signal recorded at Semeru, Indonesia. Up to six overtones can be recognized starting with a fundamental mode located at roughly 0.8 Hz.

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Methodology; why music processing tools?

- ➢ Large number of data
- ➢ Urgent need to develop new strategies to: Identify and extract data

    Reduction size strategies

    Classify records according to their origins

- ➢ Also still there are many unsolved questions about mechanism of generation of different signals in the earth

Using the similarity of seismic and acoustic waveforms

Methodology; from geophysics to music domain

| Geophysical Data (volcanic tremor) | → | Transfer into musical format (Wav) | → | Using music analysis tools | → | New data processing method in seismology |

Develop innovative seismological data processing methods by borrowing from the expertise developed in the field of MIR.

PhD Project prospect

Implication in seismological monitoring purposes

Develop an advanced signal processing tools based on MIR

Volcanic tremor analysis

| Learn different algorithms in MIR | Extract corresponding attributes in music signals and seismic waves | Rewrite MIR algorithms in a way that works fine with seismic signals | Using this new signal processing tools for monitoring volcanic activity |

An example of nice harmonic signal

Helicopter signal recorded by a near surface seismic station
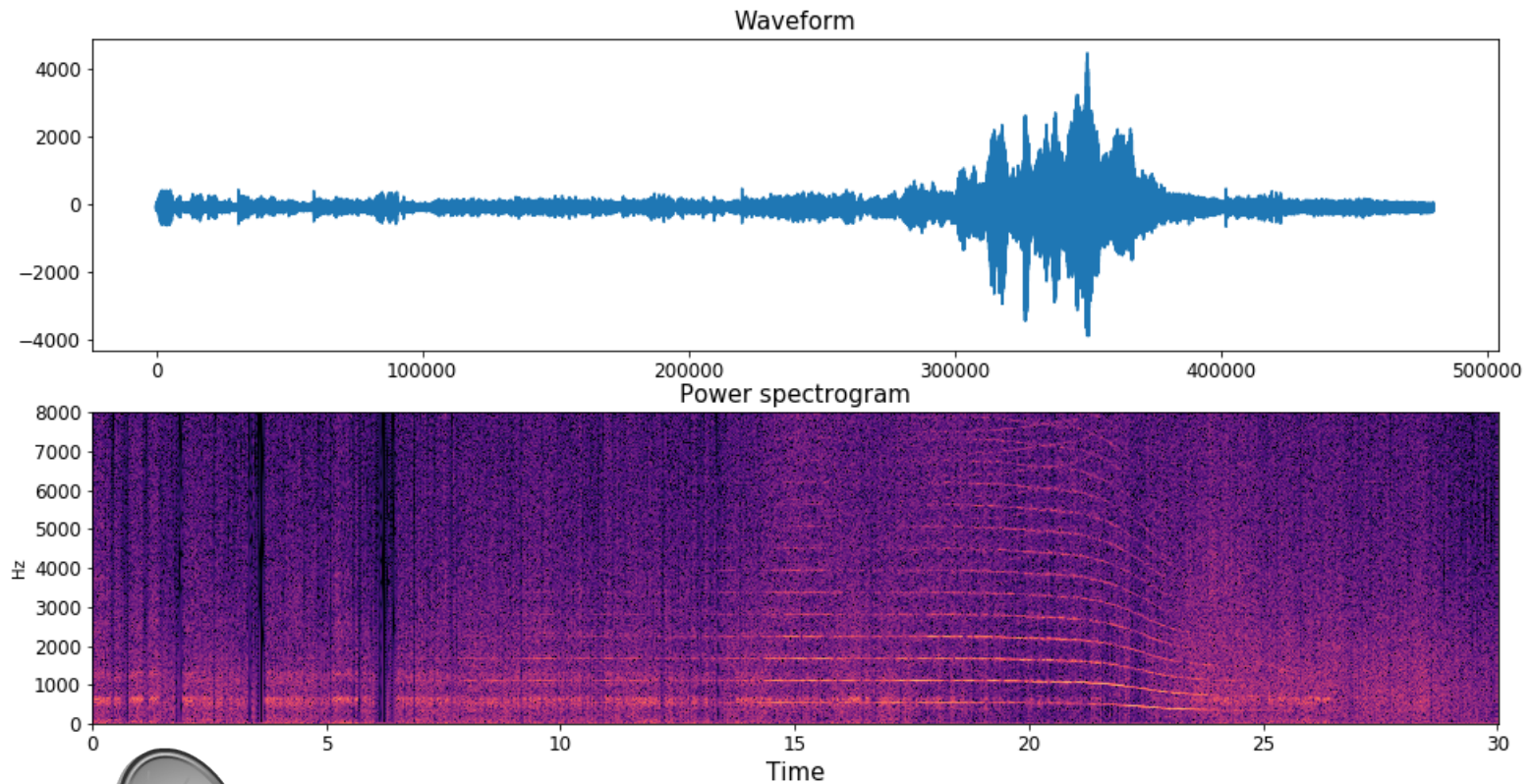
Due to changing the sampling rate frequency; the original frequency content is equal to: The frequency we see in the axis/16.
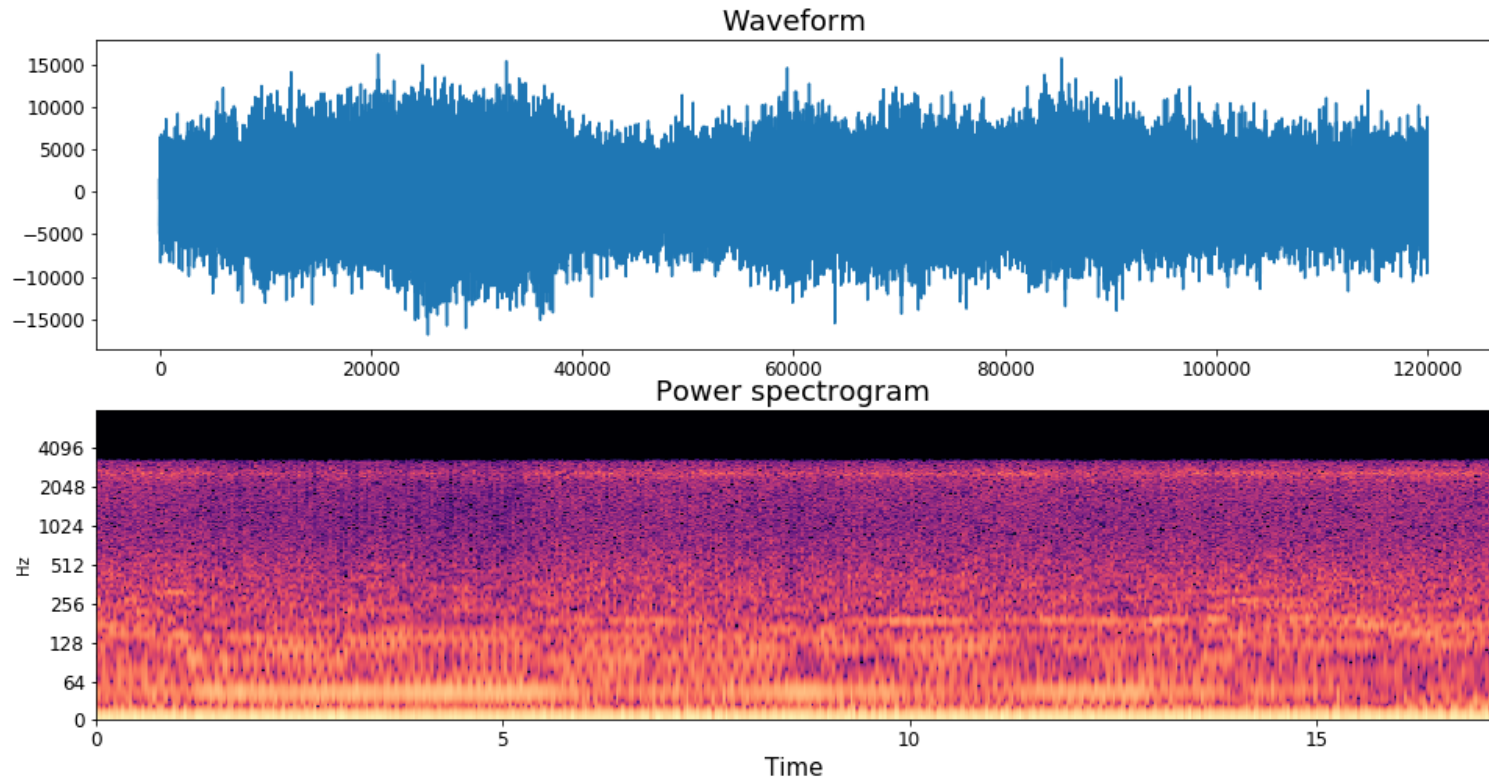
Helicopter signal analysis

Harmonic separation
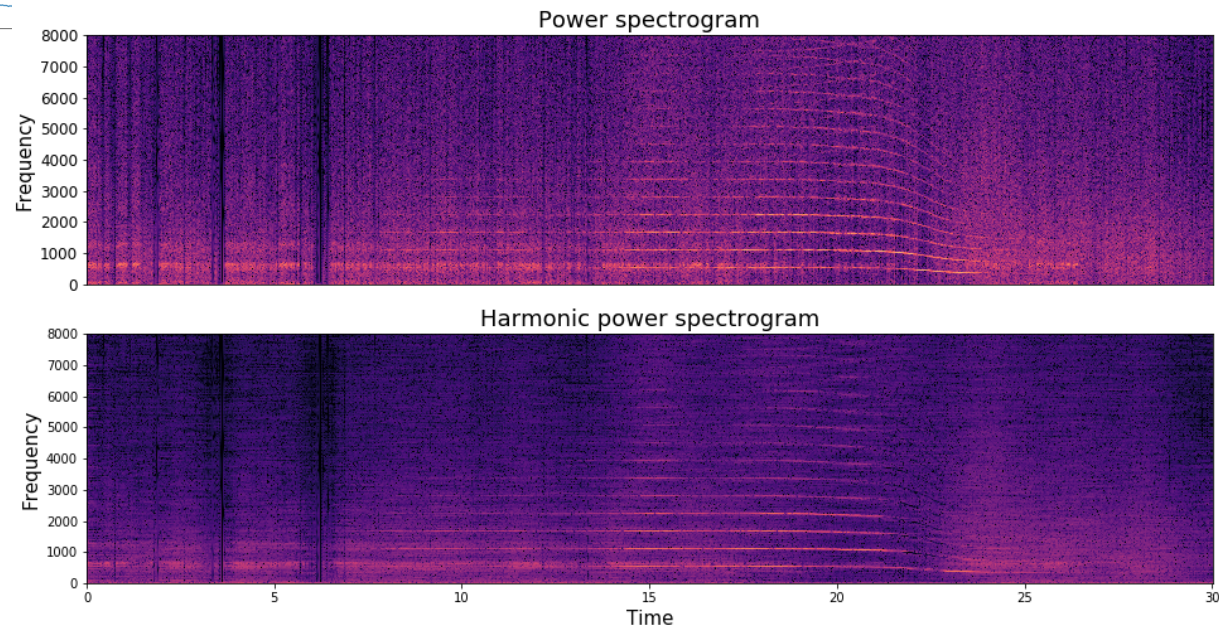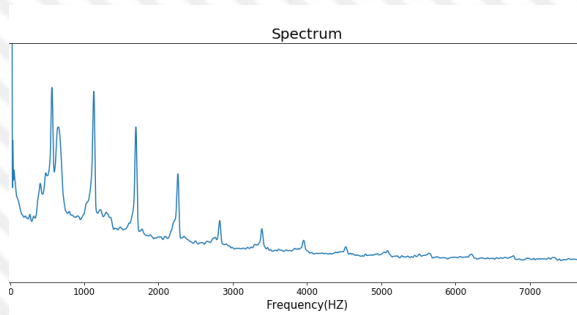
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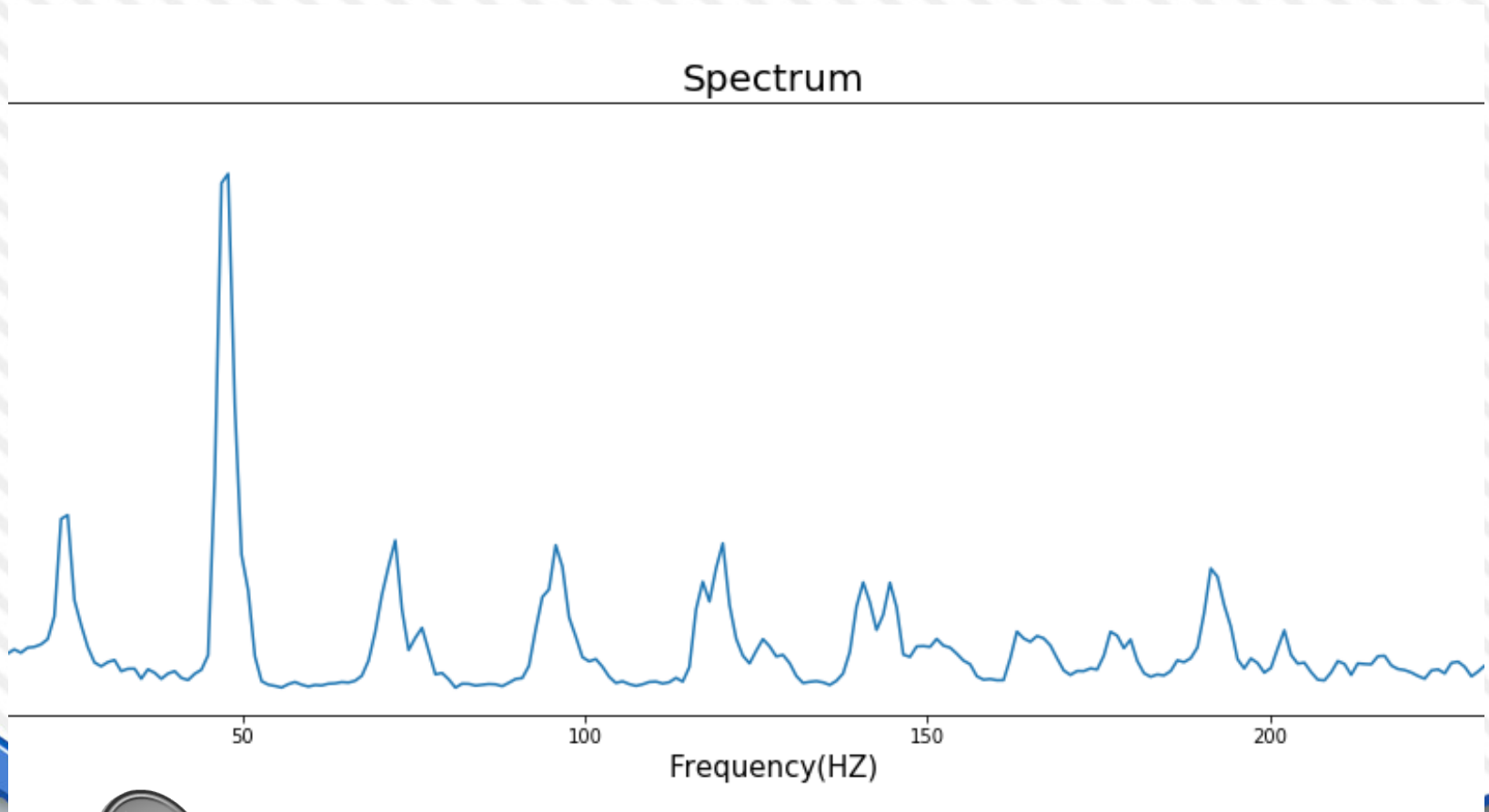
An example of volcanic tremor
Lascar volcano

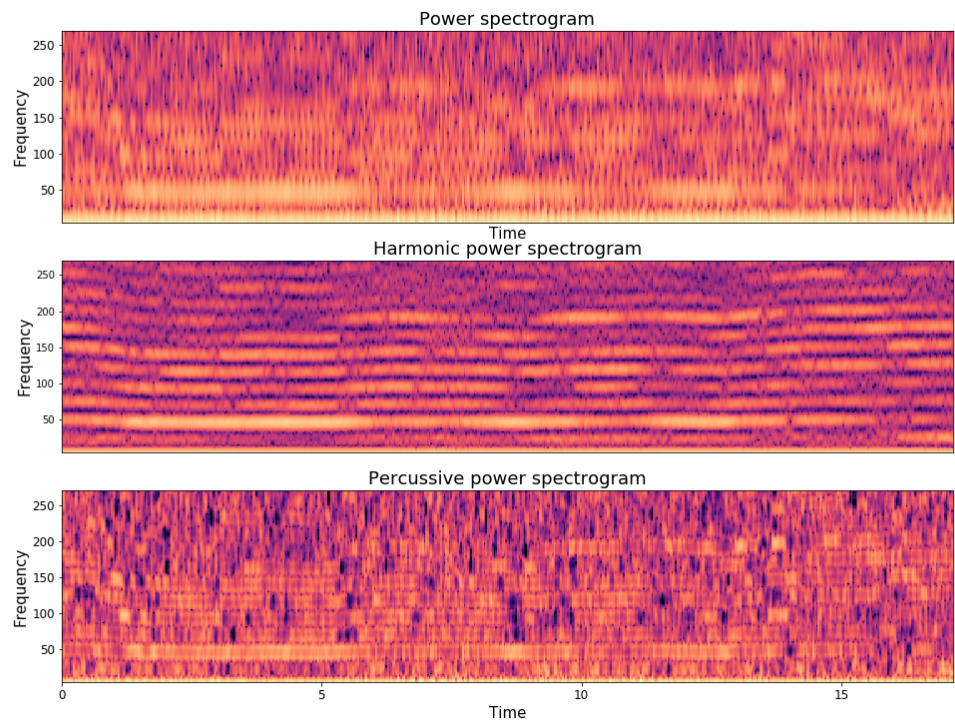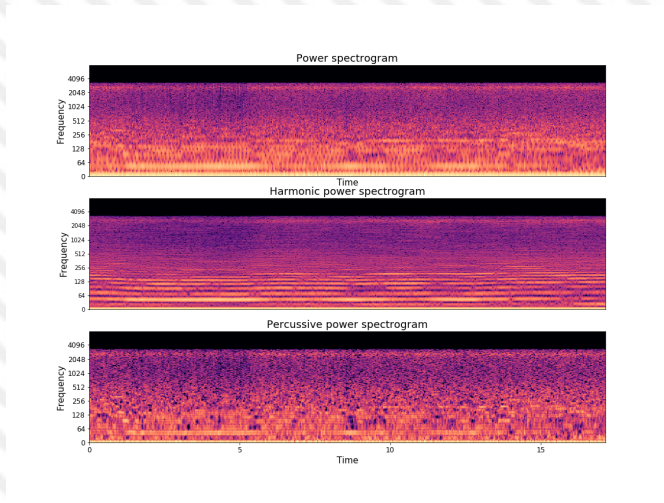

Due to changing the sampling rate frequency; the original frequency content is equal to: The frequency we see in the axis/80.

An example of volcanic tremor
Lascar volcano

Due to changing the sampling rate frequency; the original frequency content is equal to: The frequency we see in the axis/80.

An example of volcanic tremor
Lascar volcano
Harmonic-percussive separation

Due to changing the sampling rate frequency; the original frequency content is equal to: The frequency we see in the axis/80.

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Thank you