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HOW DOES A DENOISING AUTOENCODER IMPROVE EARTHQUAKE DETECTION AND THE ESTIMATION OF THEIR MAGNITUDE IN SEISMIC NETWORKS?

Janis Heuel, Meggy Roßbach, Wolfgang Friederich | EGU 2023 | NH 4.3 | April 26th, 2023



Motivation

- Denoising Autoencoders are able to suppress seismic noise even when signal and noise share a common frequency band
- New seismic events can be detected in denoised data sets
- Like other filtering techniques, denoising autoencoders reduce the amplitude of the waveform
 - \rightarrow How does it affect the calculation of earthquake magnitude?



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Catalogue building

3



Motivation | Catalogue building | Examples | Magnitude | Conclusions / Open issues

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Catalogue building



Motivation | Catalogue building | Examples | Magnitude | Conclusions / Open issues

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Examples Germany



Motivation | Catalogue building | Examples | Magnitude | Conclusions / Open issues

Sharing is concouraged



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Examples Germany

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Motivation | Catalogue building | Examples | Magnitude | Conclusions / Open issues

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Examples Germany | SX.WERN



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Motivation | Catalogue building | Examples | Magnitude | Conclusions / Open issues





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Examples Germany | BW.MANZ



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Motivation | Catalogue building | Examples | Magnitude | Conclusions / Open issues



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Examples Germany



Motivation | Catalogue building | Examples | Magnitude | Conclusions / Open issues

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Motivation | Catalogue building | Examples | Magnitude | Conclusions / Open issues

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Average decrease: 0.48 Total number of events: 425 Single denoising model for all stations 2^{2} 25



Motivation | Catalogue building | Examples | Magnitude | Conclusions / Open issues



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Conclusions / Open issues

- Using denoised data leads to a massive increase of detections
- For events with a large magnitude, the autoencoder reduces the amplitude only slightly
- For events with small magnitude, the effect on amplitude is much greater
- What is the effect on the Gutenberg-Richter relation?
- How to deal with denoised data in the future, especially when creating earthquake catalogues?

Further questions? Janis.Heuel@rub.de Code available at https://github.com/JanisHe

Motivation | Catalogue building | Examples | Magnitude | Conclusions / Open issues

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