Beitrag ID: **21** Typ: **Presentation**

LightEQ: On-Device Earthquake Detection with Embedded Machine Learning

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The detection of earthquakes in seismological time series is central to observational seismology. Generally, seismic sensors passively record data and transmit it to the cloud or edge for integration, storage, and processing. However, transmitting raw data through the network is not an option for sensors deployed in harsh environments like underwater, underground, or in rural areas with limited connectivity. This paper introduces an efficient data processing pipeline and a set of lightweight deep-learning models for seismic event detection deployable on tiny devices such as microcontrollers. We conduct an extensive hyperparameter search and devise three lightweight models. We evaluate our models using the Stanford Earthquake Dataset and compare them with a basic STA/LTA detection algorithm and the state-of-the-art machine learning models, i.e., CRED, EQtransformer, and LCANet. For example, our smallest model consumes 193 kB of RAM and has an F1 score of 0.99 with just 29k parameters. Compared to CRED, which has an F1 score of 0.98 and 293k parameters, we reduce the number of parameters by a factor of 10. Deployed on Cortex M4 microcontrollers, the smallest version of \project-NN has an inference time of 932 ms for 1 minute of raw data, an energy consumption of 5.86 mJ, and a flash requirement of 593 kB. Our results show that resource-efficient, on-device machine learning for seismological time series data is feasible and enables new approaches to seismic monitoring and early warning applications.
Next step:
We can have a more in-depth analysis of seismic data such as detection of P and S waves on the sensors.

*This paper is already accepted and peer-reviewed *

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