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On using self-sustained events for stochastic waveform modelling with deep neural networks

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The International Monitoring System (IMS) includes waveform sensor stations connected to a centralized processing system in the International Data Center (IDC) in Vienna. While the performance of the IMS is known to be related to atmospheric properties, the usual approach at the IDC still relies on expert judgments and simple models to incorporate the environmental knowledge. In this work, we develop a deep neural network (NN) that takes advantage of basic physical laws to learn a model for the stochastic component involved in wave propagation, and predict some statistics of the recorded time series. A neural network architecture is proposed which uses additional layers to embed some properties on the stochastic parameterization used to represent the atmospheric randomness, given appropriate context information on the medium (mean, standard deviation, ...). The NN model is trained on data emanating from individual stations of the IMS, using far-field self-sustained natural events such as microbaroms and high-fidelity simulation data. Finally, it is shown how this neural network architecture can be used in combination with probabilistic Bayesian models to improve network processing (detection, association) as well as our understanding of atmospheric variability.

Promotional text

We develop a new generation of deep neural network that takes advantage of basic universal laws to predict the background infrasound noise. In combination with Bayesian approaches such as NET-VISA, we believe that the neural network can enhance the association process.

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