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Deep-learning for converting noise into knowledge

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While awaiting signals from a nuclear test, the International Monitoring System (IMS) routinely detects many events that are attributed to atmospheric processes and referred to as perturbators or noise. These events, known to cause false detections, are an important source of difficulty in the network processing operated at the International Data Center (IDC). Because many thousands of events are recorded per day, recent efforts have been made in developing probabilistic inference for network processing and more recently, for estimating the energy. All these approaches, however, are based on priors that are poorly constrained, and/or extremely simplified propagation models, that are known to exhibit persistent shortcomings. In this work, we introduce a new hybrid framework to derive prior probability models from waveform modeling and take advantage of events accumulated in the analyst-reviewed bulletin. This approach is based on using current state-of-the-art propagation models in combination with a data-driven machine learning tool to model the remaining residual that is hidden in data. This approach presents two significant innovations: (1) the capability of converting perturbators into information, thereby providing a physical basis for the priors and (2) the opportunity to incorporate on a daily-basis additional atmospheric data in the priors.

Promotional text

In this work, it is shown how unsupervised learning (i.e. learning without labeled training data) can be used to extract information from signals of the IMS that can be translated into knowledge for better constraining automated tasks at the IDC.

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