A Framework for Automated Detection of Ground-Motion Signals on Seismic and Infrasound Arrays using Computer Vision, Machine Learning, and Sensor Fusion

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Abstract

The recent deployment of nodal seismic instruments and DAS sensor networks has opened up a new chapter in observational seismology. Besides earthquake-generated signals, these new types of seismic array record a larger variety of low-frequency acoustic (infrasound) signals and noise than traditional instruments. Due to the near-surface deployments of these seismic sensing systems, the composition of the signals includes ground-motion sources that are associated with the atmosphere and manmade events. Meanwhile, with rapidly-growing data volumes recorded by nodal and DAS sensors, designing an automated system that detects time periods that are contaminated by these ground motions is essential. This presentation presents a comprehensive framework for the automated detection of ground-motion signals on seismic or infrasound instruments using computer vision, machine learning, and sensor fusion. Extensive experiments were conducted on Sage Brush Flats nodal array in Southern California, and our framework provides a benchmark performance for detecting aircraft events (one of the major ground-motion sources) and demonstrates the advantage of using an array of sensors. This framework is flexible and can also be extended to detecting other common types of ground motions, and to fusing other types of sensors. By combining models/systems that detect other types of ground motion, a complete characterization of the ground motions recorded by nodal and DAS sensor networks could be obtained. In addition, the data from other types of sensors such as All-Sky cameras and ADS-B or Mode S receivers could be integrated into this framework to further refine the detection performance.

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