EGU2020-10742
https://doi.org/10.5194/egusphere-egu2020-10742
EGU General Assembly 2020

Fiber Optics foR Environmental SEnsE-ing (FORESEE) at Pennsylvania State University

Eileen Martin[1], Tieyuan Zhu[2], Junzhu Shen[2], Srikanth Jakkampudi[1], Weichen Li[1], and Ayush Dev[1]
[1]Virginia Tech, Blacksburg, VA, USA (eileenrmartin@vt.edu)
[2]Pennsylvania State University, University Park, PA, USA

The FORESEE Distributed Acoustic Sensing (DAS) Array records roughly 1/3 terabyte of data per day along 5 kilometers of dark fiber optic telecommunications cable underneath the Pennsylvania State University campus. The campus sits in the Allegheny Mountain region of the US, and our aim is to understand urban hydrology and detection of geohazards (particularly karst features). We have verified a number of features of these data similar to prior urban seismic studies, both in ambient noise and in distant earthquake records, which builds further evidence that dark fiber can be a useful tool for seismology in cities.

These data also contain a number of new signals not observed on previous dark fiber arrays. We see a stronger response to air waves than prior experiments. For instance, musical bass lines are clearly observed in the 30-100 Hz range during a concert, and we can see the spatial decay of higher versus lower frequencies throughout the array. This is the first dark fiber array in the eastern US, where thunderstorms occur with some frequency, and we have observed clear recordings of ground motion due to thunder. Source inversion of the waveforms throughout the array leads to locations that show reasonable agreement compared to the National Lightning Detection Network. These thunderquake signals could be an important source of broadband energy for seismic imaging in an area with little earthquake seismicity.

We have performed ambient noise interferometry throughout the array with a variety of pre-processing workflows, but some subsets of the array are strongly affected by nearby sources. With the wide variety of natural and manmade signals in these data, we are working towards further efficient automation to detect repeatable signals that could be used for targeted interferometry, and methods to automate filtering of non-ideal noise sources. As one example of filtering a specific noise, we were surprised the array is able detect the paths of individuals walking along a sidewalk by the fiber. While this array records data on a public college campus, a likely future area of research may include urban areas with a mix of commercial and residential purposes, so we desire tools to remove individual signals as they are recorded. Thus, we have developed a neural network to detect and remove footsteps from data before those data are shared with researchers. To encourage others working on urban seismic acquisition to remove similar signals, we are generalizing these methods for footstep removal to different scales.