Bay Area Geophysical Society Seminar Series

Distributed Acoustic Sensing using Dark Fiber for Seismological Applications

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In-person in Room 325 at McCone Hall (UC Berkeley campus) and on Zoom

Abstract:

The application of distributed acoustic sensing (DAS) to subsurface fiber-optic cables has revolutionized our ability to acquire high-resolution seismic data. DAS can provide dense, wide bandwidth, and continuous long-duration seismic recordings with spatial resolutions of a few meters over distances of a few tens of kilometers, which can be used in various seismological applications. This talk will demonstrate various applications of DAS data acquired on pre-existing unused subsurface fiber-optic cables deployed for telecommunication, known as dark fiber. We present DAS observations from a 27 km long array in Imperial Valley, Southern CA, a region of active tectonics, intense seismicity, high heat flow and geothermal production.

In regions of intense seismicity, body wave arrival times from local earthquakes can be used to image the subsurface. Dense observations provided by DAS arrays have significant potential in enhancing resolution in regions with sparse coverage from permanent seismic networks. DAS is also sensitive to ambient microseismic noise. Surface-wave imaging using ambient seismic noise cross-correlation has been applied successfully to DAS arrays, but is often restricted to Rayleigh-wave imaging and 2D imaging along straight segments of DAS arrays due to the sensitivity of DAS being limited to axial strain along the cable. We demonstrate that mixed-sensor cross-correlation of velocity noise recorded by three-component seismometers and strain-rate noise recorded by DAS arrays permits separate analysis of Rayleigh waves and Love waves and allows 3D tomography using seismometers surrounding a DAS array. DAS data can also be used for studying earthquake source properties. We apply the empirical Green's function deconvolution method to pairs of co-located earthquakes with similar waveforms, which eliminates the wave propagation effects, site response and instrument response common to both earthquake records, leading to a reliable estimate of relative source properties. We find good agreement in relative source-time function from the DAS strain-rate data and velocity data from nearby permanent seismometers for local earthquakes.

Presenter's Bio:

Avinash Nayak is a seismology postdoc at Lawrence Berkeley National Laboratory. His current research focuses on various applications of distributed acoustic sensing data in earthquake and ambient noise seismology. He obtained his PhD at Univ. of California Berkeley in 2017, working on seismic moment tensor inversion using 3D velocity models, source-type characterization of small magnitude seismic events and hydrothermal tremor signals. Previously, he has worked on body-wave tomography and surface-wave tomography at a range of spatial scales as a postdoc at Univ. of Wisconsin Madison.

Zoom meeting information:

Zoom ID: 960 4392 9213

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