DISTRIBUTED ACOUSTIC SENSING FOR NEAR-SURFACE APPLICATIONS

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Distributed Acoustic Sensing (DAS) is used in the oil and gas industries for vertical seismic profiling (VSP). The goal of this study is to investigate the use of DAS for near-surface applications. DAS consists of an optical fiber cable connected to an optical interrogator, which injects pulses of coherent light into the fiber and receives backscattered light. For near-surface seismic applications the fiber optic cable is buried at shallow depths, typically less than a meter. Seismic disturbances strain the buried optical fiber and change the optical path length, which results in phase changes of the backscattered light measured by the interrogator. These changes are probed at sequentially discrete zone lengths along the entire length of the fiber, providing an array of continuous sensors on a single strand of fiber. Experiments were performed at a test site where several kilometers of fiber optic cable had been buried at sub-meter depths. Arrays of vertical geophones were installed at the surface along the path of the cable. Impulse hammers created seismic waves, which were simultaneously recorded with the geophones and the DAS. A method for quantifying the repeatability of the signals recorded with the two types of sensors was developed. It entails calculating the correlation coefficients between multiple signals recorded with the same source at the same location. In addition, the coherence function was calculated for signals recorded from different sections of the fiber sensor to determine the suitability of using array-processing techniques with DAS. Finally, the two sensor systems were used to conduct surveys employing surface wave methods and the results were compared. Although the seismic surveys conducted with geophones provided higher fidelity results the DAS results were in agreement, thus demonstrating its suitability for long term monitoring.