A Field Test in Preparation for Long-Range Distributed Acoustic Sensing in Subsea Applications

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Over the past several years distributed fiber-optic sensing (DAS) has been to a variety of seismic and seismological applications. Many particular optical and acquisition parameters can be optimized but practically the ultimate signal quality is determined by a combination of effective sensing extent and required sensitivity. Industrial seismic applications perform measurements on distances on the order of a few km with signal frequencies as high as many kHz, while seismological applications tend to measure signals on the order of 40-50 km distance with lower frequency content.

Due to having many active or passive optical components subsea installations are often non-optimal for sensing purposes. A series of built-in losses at connectors, splices, penetrators, as well as other optical components, leads to typical light propagation loss-budgets of 8-11 dB. For seismological applications these budgets are suitable for the larger gauge lengths due to the lower frequency waves of interest. However, for higher frequency applications, smaller gauge lengths and pulse widths are required, while still overcoming the light propagation losses
To demonstrate that we can properly interrogate, we acquired field test data on-shore utilizing boreholes and surface layouts with a 5 km section of fiber after a 30 km lossy lead-ins, which is a typical scenario for industrial seismic applications. The data acquisition utilized standard telecom and borehole fiber cables permanently deployed at an on-shore field site. A low-energy vibrator with sweep frequencies from 8-150 Hz was used. High SNR seismic wave fields containing direct arrivals, refractions and reflections in all active sensing sections. The results show that state-of-the-art DAS interrogators can be used efficiently in a practical field setting for various subsea sensing applications. Future applications include long-reach subsea surface and borehole-based sensing for seismic imaging purposes, and opportunistic interrogation of active or abandoned boreholes.

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