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C-OTDR Based Quasi-distributed Vibration Sensing Using High Scattering Fiber Segments - Performance for Subhertz Dynamic Strain Events

R. Eisermann* (BAM), K. Hicke (BAM) & K. Krebber (BAM)

SUMMARY

Distributed vibration sensing (DVS) based on Rayleigh single pulse optical time-domain reflectometry (C-OTDR) is an attractive and robust method for a variety of sensing applications including geosensing. A key issue for the usability of DVS systems is the signal-to-noise ratio (SNR) and thus the feasibility to demodulate a measured signal, especially in the case of small dynamic strain amplitudes. We present a simple method to locally boost the sensitivity of DVS using pairs of fs-laser-written strongly scattering fiber segments.

Abstract

Distributed vibration sensing (DVS) based on Rayleigh single pulse optical time-domain reflectometry (C-OTDR) is an attractive and robust method for a variety of sensing applications including geosensing. A key issue for the usability of DVS systems is the signal-to-noise ratio (SNR) and thus the feasibility to demodulate a measured signal, especially in the case of small dynamic strain amplitudes. We present a simple method to locally boost the sensitivity of DVS using pairs of fs-laser-written strongly scatteringfiber segments. To demonstrate our approach, we conducted experiments performing dynamic strain measurements in a temperature-stable environment to minimize sensitivity fading caused by thermal drift. Dynamic strain signals were applied by introducing localfiber elongations via a voltage modulation of a piezo element. Our results show that a significant gain in sensitivity can be achieved when using the strong scattering segments as compared to a non-modified standard opticalfiber. Furthermore, we could show that it is possible to reconstruct subhertz dynamic strain signals with triangle waveform.

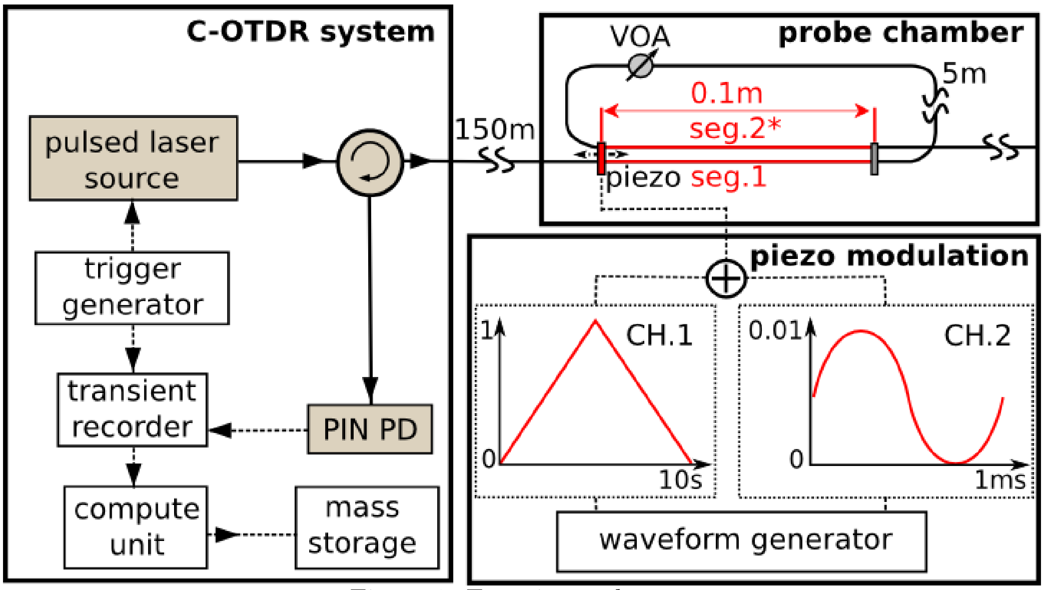

Figure 1: Experimental setup

Further author information: (Send correspondence to René Eisermann)
René Eisermann: E-mail: rene.eisermann@bam.de, Telephone: +49 30 8104-4344