engineering proceedings

MDPI

Poster

Brillouin optical correlation-domain reflectometry with differential spectrum scheme for distributed strain sensing at a distance

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Abstract: Research on distributed optical fiber sensing techniques is advancing rapidly, particularly in the field of strain and temperature sensing using Brillouin scattering. Among the proposed Brillouin sensors, Brillouin optical correlation-domain reflectometry (BOCDR) utilizes spontaneous Brillouin scattering. BOCDR operates by injecting light into one end of a measurement fiber (FUT) and boasts unique features such as millimeter-scale spatial resolution, random access capability, and cost-effectiveness. It employs a method that synthesizes the optical coherence functions, enabling interference between modulated signal light and reference light, resulting in "correlation peaks" along the FUT. By scanning these peaks, the distribution of the Brillouin gain spectrum can be obtained, maintaining a constant ratio between spatial resolution and measurement range. In conventional systems, only one correlation peak is present within the FUT, limiting the measurement range. However, approaches including time gating, dual modulation, and chirp modulation have been proposed to extend the range while preserving spatial resolution, albeit at higher device and design costs. To overcome this limitation, our study introduces the "differential spectrum method" for measuring strain distribution near the open end of the FUT, beyond the theoretical measurement range. Assuming a constant temperature and the absence of strain application sections along the proximal part of the FUT, this method generates multiple correlation peaks within the FUT and utilizes signal processing techniques to eliminate scattering effects from correlation peaks other than the measurement point. This cost-effective and straightforward approach enables strain distribution measurement in remote locations.

Keywords: Distributed optical fiber sensors; Brillouin scattering

Citation:

Academic Editor(s): Name

Published: date