ロックイン検出法を用いたブリルアン光相関領域リフレクトメトリ

Brillouin Optical Correlation Domain Reflectometry with Lock-in Detection Scheme

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A Brillouin optical correlation domain reflectometry (BOCDR) with lock-in detection scheme is proposed and verified. The experimental setup is shown in Fig.1. The light from the distributed feedback laser diode (DFB-LD), which has been frequency modulated at f_m, is divided into two branches. The pump light is amplified and injected into the 100m fiber under test (FUT). A 6cm and a 4cm section on the fiber are applied with strain. The backscattering is amplified and filtered with a tunable bandpass filter (TBF) to eliminate the Rayleigh scattering. The reference light is phase modulated after passing through a 1.5km delay fiber. The PM modulation waveform is in an on/off way at the lock-in frequency f_L. The reference light and the Brillouin scattering is combined and detected with the balanced photodetector (PD). The beating spectrum is detected by the electrical spectrum analyzer (ESA) and amplified by the lock-in amplifier (LIA) through the analog output function of ESA.

In the experiment, the laser modulation frequency f_m is around 944.5kHz, and the modulation depth Δf is ~20GHz. Therefore, the nominal spatial resolution is 5cm and the measurement range is 105m. Note that Δf used in the experiment is larger than the 5.4GHz limitation [1]. As the Rayleigh scattering is eliminated completely, the beating spectrum can be detected correctly without the influence from the Rayleigh component, although the Brillouin scattering spectrum is incomplete. Fig.2(a) shows the distributed Brillouin spectrum. The 6cm and 4cm sections with strain applied are successfully detected. Fig.2(b) shows the Brillouin spectrums at the 6cm section with different strains. The Brillouin frequency shift is almost linear to the strain.

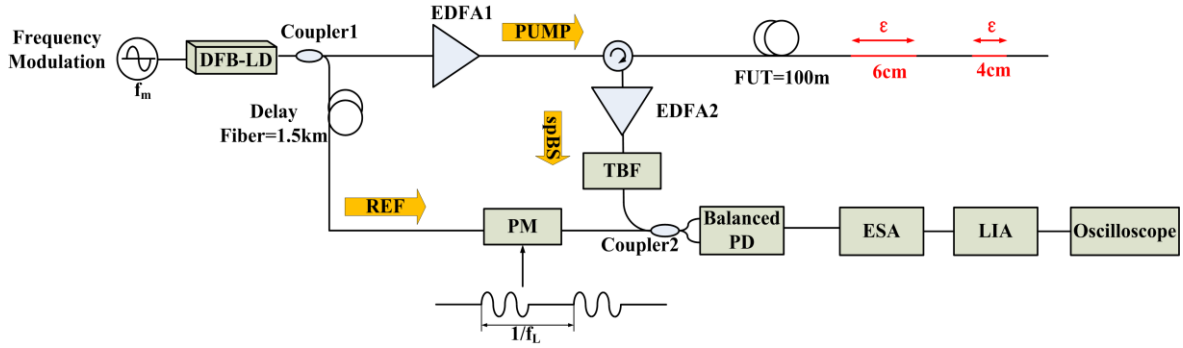

Fig.1. Experimental setup of BOCDR with lock-in detection scheme.

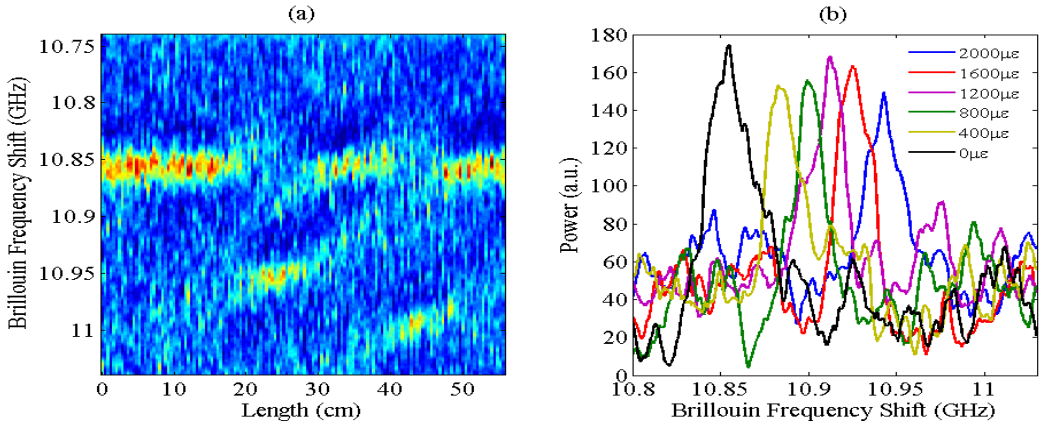

Fig.2. (a) Distributed Brillouin spectrum at the 6cm and 4cm sections with strain. (b) Brillouin spectrums at the 6cm section with different strains.

Reference

[1]Y. Mizuno, W. Zou, Z. He, and K. Hotate, *Opt. Express*, vol. 16, pp. 12148-12153, 2008.