# ポンプ光周波数掃引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 Pump Light Frequency Sweeping Scheme

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Brillouin optical correlation domain reflectometry (BOCDR) is a technique to measure the distributed strain and/or temperature along an optical fiber, by utilizing the dependence of Brillouin frequency shift (BFS) of spontaneous Brillouin scattering on strain and/or temperature[1,2]. In a standard BOCDR system, the electrical spectrum analyzer (ESA) is used to observe the Brillouin spectrum, by sweeping the frequency of the electrical local oscillator in the ESA[1]. However, in this scheme, the electrical background noise of the ESA may influence the detection of the Brillouin spectrum, especially when the BOCDR system works with a high spatial resolution and the signal is weak and comparable with the intrinsic electrical noise in the ESA. In this paper, we propose the pump light frequency sweeping scheme to overcome this problem. In this scheme, the frequency sweeping is realized in optical domain and the ESA is set under zero-span mode, to eliminate the electrical background noise. The optical frequency sweeping is implemented on the pump light but not the reference light, to avoid the fluctuation of the reference light power.

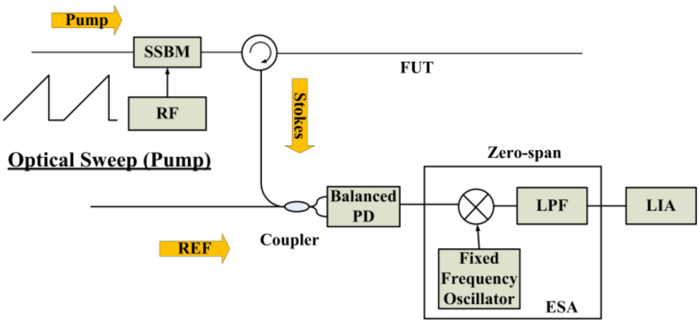


Fig.1. Principle of BOCDR with pump light frequency sweeping scheme.

Fig.1 shows the principle of the BOCDR with pump light frequency sweeping. The optical frequency sweeping of the pump light is realized by using a single sideband modulator (SSBM). The reference light frequency is kept constant to ensure the intensity stability. The beating spectrum detected by the balanced photo-detector (PD) is analyzed by ESA working under zero-span mode, and processed by the lock-in amplifier (LIA) [3].

The experiment is performed over a 3m optical fiber under test (FUT), with a 4cm section applied with 0.5% strain. The laser modulation frequency for the position selective measurement of BOCDR [2] is 19.9278MHz~20.0278MHz, and the modulation amplitude is 5.4GHz. Therefore, the nominal measurement range is 5m, and the spatial resolution is about 8.8mm [2]. Fig.2 shows the Brillouin spectrums measured at the positions with no strain and with 0.5% strain. The BFS change induced by the strain can be observed clearly. The proposed scheme realizes a high spatial resolution without complicated system for suppressing the background noise.

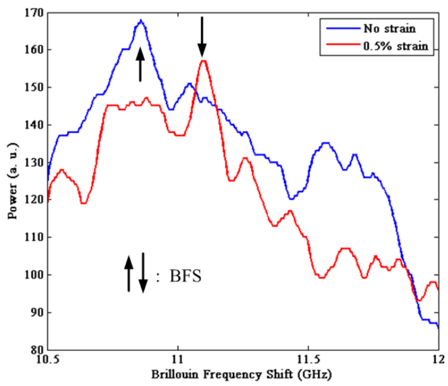


Fig.2. Brillouin spectrums measured at the positions with 0 and 0.5% strain.

References

[1] Y. Mizuno, W. Zou, Z. He, and K. Hotate, *Optics Express*, vol. 16, pp. 12148-12153, 2008.
[2] K. Hotate, *Optical Fiber Technology*, vol. 19, pp. 700-719, 2013.
[3] Y. Yao, M. Kishi, and K. Hotate, *Applied Physics Express*, vol. 9, pp. 072501, 2016.