## ブリルアン光相関領域リフレクトメトリにおける 5.4GHz を超える周波数変調振幅に関するシミュレーション Simulation of Widening Frequency Modulation Amplitude over 5.4GHz in Brillouin Optical Correlation Domain Reflectometry <sup>○</sup>姚 雨果、岸 眞人、保立 和夫(東大) The University of Tokyo, <sup>°</sup>Yuguo Yao, Masato Kishi, and Kazuo Hotate E-mail: {yao, mkishi, hotate}@sagnac.t.u-tokyo.ac.jp

The Brillouin optical correlation domain reflectometry (BOCDR) is one of the optical fiber distributed sensing technologies used to measure the distribution of temperature and/or strain along an optical fiber [1]. It is known that when the frequency modulation amplitude  $\Delta f$  is larger than 5.4GHz in BOCDR, the noise that comes from the Rayleigh scattering will overlap with the spectrum of the Brillouin scattering [1,2]. In this paper, we will describe the method of widening the  $\Delta f$  to over 5.4GHz in BOCDR system, by using an optical filter to exclude the Rayleigh scattering. A simulation regarding the influence on the spatial resolution will be presented.



Figure 1. Principle of BOCDR (a) when  $\Delta f = 5.4$ GHz, and (b) when  $\Delta f = 10.8$ GHz

In Fig.1(a), the principle of ordinary BOCDR when  $\Delta f$ =5.4GHz is shown. In Fig.1 (b), the schematic of the proposed method is shown when  $\Delta f$  is set to 10.8GHz. In Fig.1(b), the frequency modulation at  $f_m$  applied on the Brillouin scattering is maintained, but only the half of the Brillouin scattering with lower optical frequency is kept, and the other half with higher frequency is wiped out by the optical filter to exclude the Rayleigh scattering.



Figure 2. BGS shapes calculated for the fiber under test including the section with -20MHz Brillouin frequency shift located at the correlation peak position, with changing its length (0.9, 0.7, 0.5, 0.3% of the total length) (a)  $\Delta f$  =5.4GHz, and (b)  $\Delta f$  =10.8GHz.

Fig.2 shows the simulation results of the Brillouin gain spectrum (BGS), when the fiber section of different length (0.9, 0.7, 0.5, 0.3% of the total length) located at the correlation peak position is applied with the Brillouin frequency shift of -20MHz. It is shown, when  $\Delta f$ =5.4GHz, that the section shorter than 0.7% cannot be clearly detected. The spatial resolution is considered to be about 0.7%. However, when  $\Delta f$ =10.8GHz and the optical filter is applied, the 0.5% section can be measured, while the 0.3% section cannot be detected. The spatial resolution is considered to be around 0.4% of the total length. Therefore, we could conclude that the proposed method is effective to enhance the spatial resolution of BOCDR. The relationship between the spatial resolution  $\Delta z$  and the frequency modulation amplitude  $\Delta f$  roughly obeys  $\Delta z \propto 1/\Delta f$ , even when  $\Delta f$  is over 5.4GHz and the optical filter is applied.

## References

[1]Y. Mizuno, W. Zou, Z. He, and K. Hotate, Opt. Express, vol. 16, no.16, 12148-12153 (2008).

[2]Y. Mizuno, W. Zou, Z. He, and K. Hotate, J. Lightwave Technol., vol. 28, no. 22, pp. 3300-3306 (2010).