

Millimeter Wave Generation Using Spontaneous Four Wave Mixing

Hang Lung Kuo¹, Wen Piao Lin²

^{1,2} Optical Communication Laboratory, Chang Gung University, Taiwan
E-mail: hugogo7646@gmail.com

1. Introduction

We proposed two different models of millimeter wave (MMW) generating using spontaneous four-wave mixing (FWM) of high nonlinear fiber (HNLF). Not like other methods: MZM [1], dual-wavelength mode-lock [2], line-by-line shaper [3]. The structure of the two simulated models is simple and tunable for higher MMW frequency, and is proved by utilizing simulation software of OptiSystem.

2. Structure and Simulation

In order to avoid the disadvantage of current millimeter wave generation method which is expensive and complicated[1-4], we proposed a new idea of using spontaneous four-wave mixing to generate millimeter wave. The structures of two FWM millimeter wave models are shown in Fig.1, both use a Erbium Doped Fiber Amplifier (EDFA) to enhance the input continuous wave(CW) laser source in order to stimulate the nonlinear effect of high nonlinear fiber(HNLF). The difference of input laser wavelength and fiber Bragg grating(FBG) reflect wavelength is set to about 100GHz. When the high power laser goes into the loop or linear cavity composed by HNLF, circulator, FBG and coupler, different wavelength will emerge from the back noise because the four-wave mixing effect of HNLF. We use a filter to choose two wavelengths from the output as shown in Fig.2(a), and then use a photodetector(PD) to get the millimeter wave as

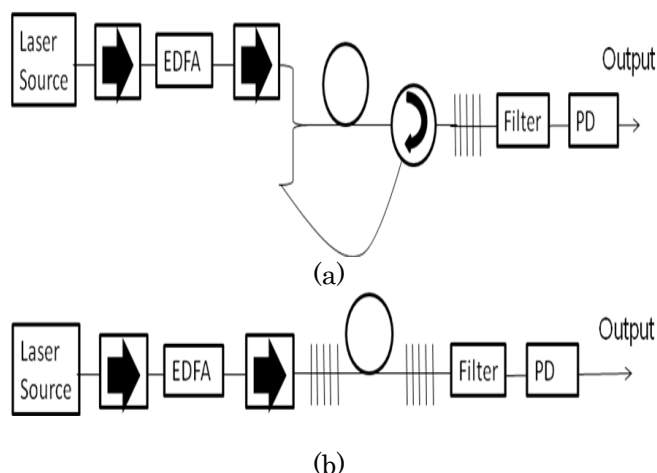


Fig.1 Two FWM millimeter wave models (a)Fiber loop cavity model, (b)linear cavity model

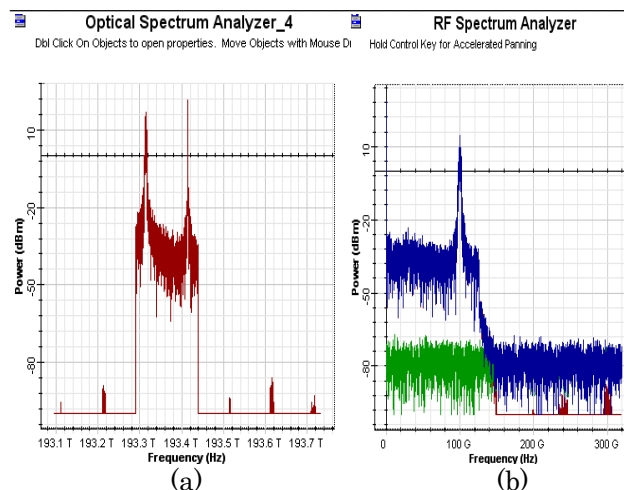


Fig.2 Output from the (a)filter and (b) PD in Fig.1

shown in Fig.2(b). The purpose of the FBG is to stabilize the FWM process and choose the frequencies we want to emerge in the cavity. It can be noticed that the structure is simple and easy to build, the frequency of millimeter wave can be easily changed just by adjusting the input frequency.

3. Conclusion

We proposed a new millimeter wave generation idea by utilizing four-wave mixing and proved using simulation software OptiSystem. The structure is simple and the millimeter wave frequency is easy to tune by adjusting the input frequency.

References

- [1] C.T. Lin, J. Chen, P.T. Shih, W.J. Jiang, and S. Chi, "Ultra-high data-fiber systems employing optical frequency multiplication and OFDM formats," *Journal Lightwave Technology*, vol. 8, pp.2296-2306, Aug. 2010
- [2] P. Acedo, C. Roda, H. Lamela, G. Carpintero, J.P. Vilcot, S. Garidel, "Novel Dual-mode locking semiconductor laser for millimetre-wave generation", *Proc. of SPIE Vol. 5958* (2005)
- [3] C.W. Chow, L.G. Yang, C.H. Yeh, C.B. Huang, J.W. Shi, and C.L. Pane, "10 Gb/s optical carrier distributed network with w-band (0.1THz) short-reach wireless communication system," *Optics Communications*, vol.285, issues 21-22, pp.4307-4311 59580V-11, (2012)
- [4] Z. Jia, J. Yu, Y.T. Hsueh, A. Chowdhury, H.C. Chien, J. A. Buck, and G.K. Chang, "Multiband signal generation and dispersion-tolerant transmission based on photonic frequency tripling technology for 60-GHz radio-over-fiber systems," *IEEE Photonics Technology Letters*, vol. 20, Issue18, pp.1470-1472, Sep.2008