Optical Nyquist Pulses Generation by Recirculating Frequency Shifting

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I. Introduction

Since the rapid growth of data in optical networks, new solutions are urgently needed to meet the increasing demand for bandwidth. In order to solve this problem, Nyquist optical time division multiplexing(N-OTDM), a scheme with potential to achieve ultra-high data transmission, is proposed and attracted wide attention. To realize N-OTDM, it is necessary to generate high-quality Nyquist pulses, which have a rectangular spectrum in frequency domain and a sinc-shaped waveform in time domain. According to this characteristic, Nyquist pulses can effectively improve the spectrum efficiency of the communication system, reduce inter-symbol interference (ISI), and increase the tolerance to nonlinear damage and dispersion.

we propose a method for generating optical Nyquist pulses with tunable duty cycle by recirculating frequency shifting (RFS), which can produce ultra-flat and phase-locked OFCs.

II. PRINCIPLE

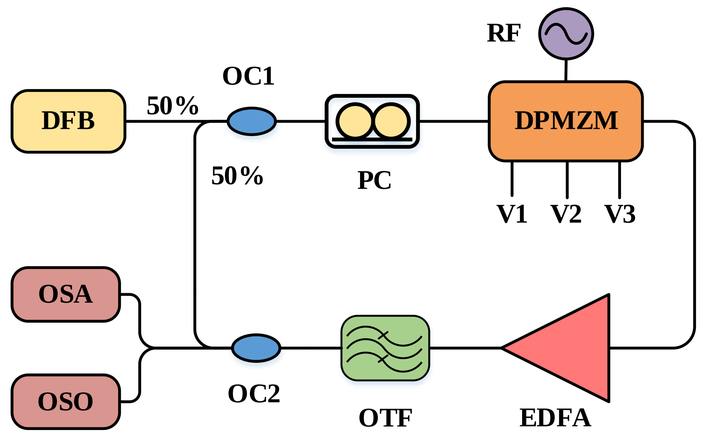

Figure 1. Schematic diagram for Nyquist pulses generation with tunable, ultra-flat and rectangular-shaped OFCs.

III. RESULTS AND DISCUSSION

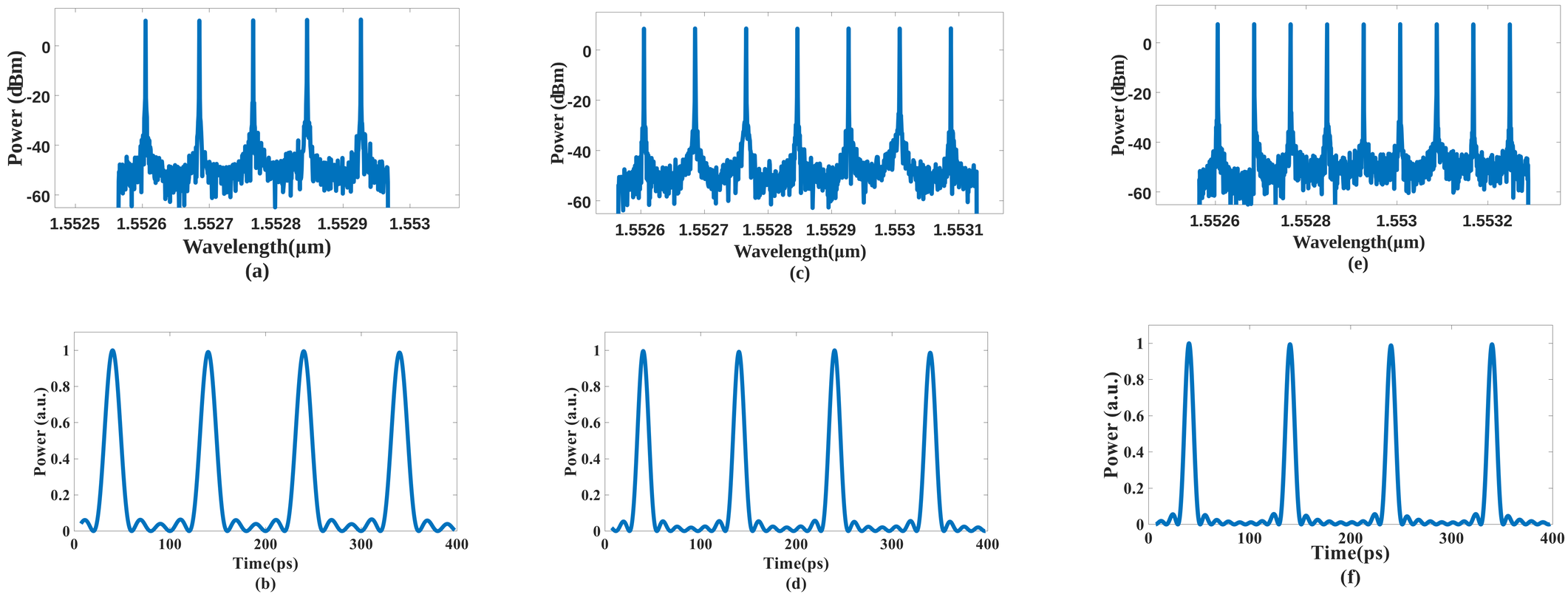

Figure 2. (a) Optical spectrum with 5 flat comb lines and (b) its temporal waveform of the generated Nyquist pulses. (c) Optical spectrum with 7 flat comb lines and (d) its temporal waveform of the generated Nyquist pulses. (e) Optical spectrum with 9 flat comb lines and (f) its temporal waveform of the generated Nyquist pulses.

Figure 2 (a), (c) and (e) show the spectrogram of the OFCs with 5 comb lines, 7 comb lines and 9 comb lines respectively. Their power variations among comb lines are all measured to be below 0.1 dB. And the frequency interval between the comb lines is 10 GHz. Figure 2 (b), (d) and (f) show the time-domain waveforms corresponding to different OFCs. The time periods of these waveforms are all 100 ps. However, in figure 2(b), the full width at half maximum(FWHM) of the Nyquist pulses is 18.96 ps, and its duty cycle is 18.96%. In figure 2(d) the FWHM is 12.7 ps, and its duty cycle is 12.7%. In figure 2(f) The FWHM is 9.76 ps, and its duty cycle is 9.76%.

IV. CONCLUSION

In conclusion, we have demonstrated a new method to generate optical Nyquist pulses by using RFS. Through this method, optical Nyquist pulses with tunable duty cycle are generated ,which will facilitate the realization of N-OTDM and achieve ultra-fast data transmission.

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