Nyquist Pulses Generation with Tunable Duty Cycle by Spectrum Broadening and Chirp Compensation

Hui Wang, Jiakang Li, Dongfang Jia, Chunfeng Ge*, Zhaoying Wang, and Tianxin Yang*

Laboratory of Fiber Optics and Optical Communication, School of Precision Instrument and Optoelectronics Engineering, Tianjin University, Tianjin 300072, China
*** jiadf@tju.edu.cn, gechunfeng@tju.edu.cn**

I. Introduction

In this paper, we experimentally demonstrate a simple method to generate Nyquist pulses with 5 flat phase-locked comb lines employing a single DPMZM. On this basis, we propose a novel approach to generate Nyquist pulses with flexible set of duty cycle based on spectrum broadening and quasi-linear chirp compensation.

II. Principle

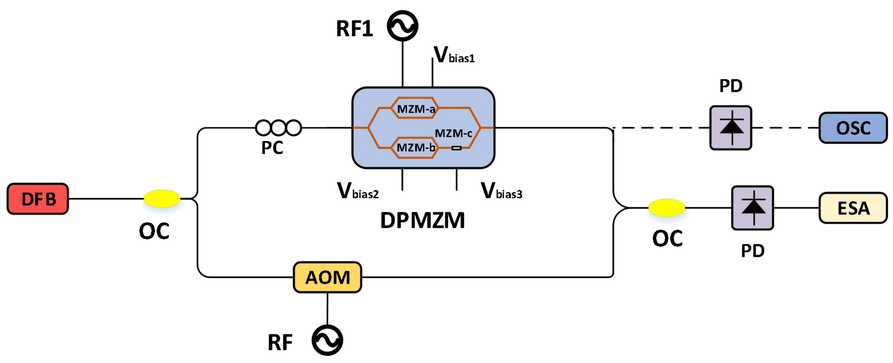

Figure 1. Experimental setup to generate Nyquist pulse with 5 comb lines.

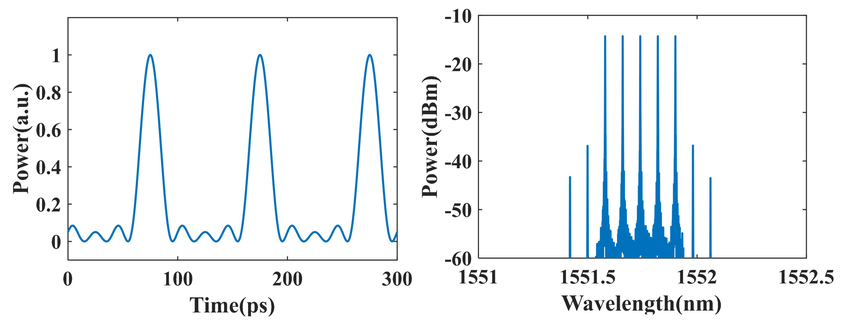

Figure 2. The output of a single DPMZM

A simple method to generate Nyquist pulses with 5 flat phase-locked comb lines and a duty cycle of 21.6% employing a single DPMZM.

III. Further Study

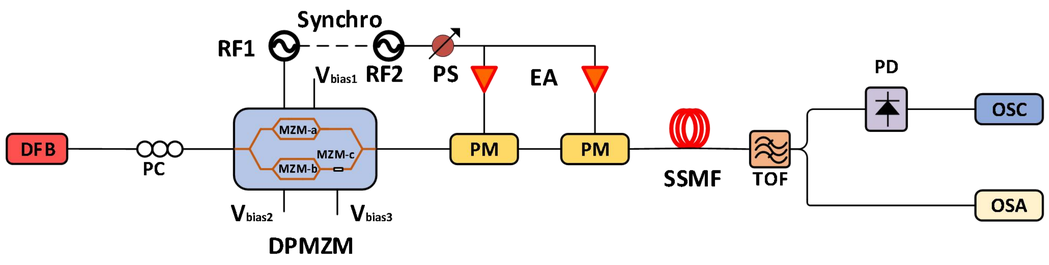

Figure 3. Schematic of the proposed scheme.

A flexible Nyquist pulse generator based on the spectrum broadening and frequency chirp compensation. We first make the DPMZM work as an ultra-short pulse generator and employ two phase modulators (PMs) to broaden its spectrum.

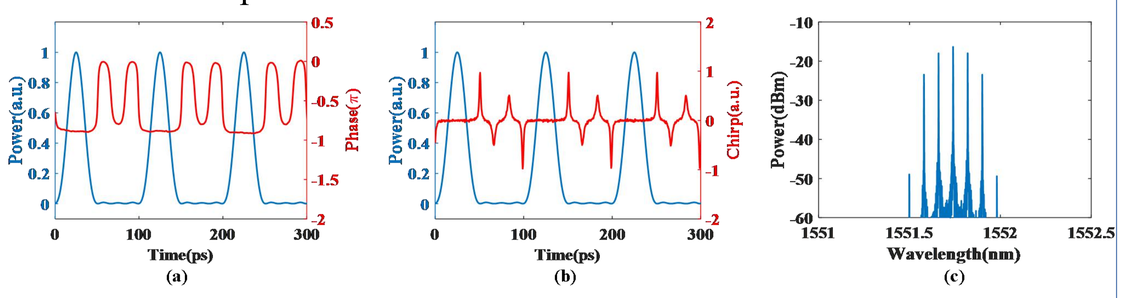

Figure 4. The output of the DPMZM: (a)temporal waveform (blue line), phase (red line), (b)temporal waveform (blue line), chirp (red line), and (c)spectrum before two PMs.

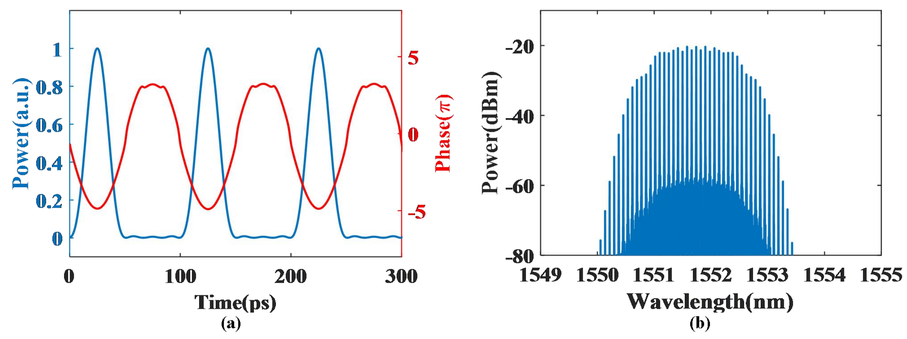

Figure 5. (a)temporal waveform (blue line), phase (red line) and (b)spectrum after two PMs.

We can see that the phase is quasi-parabolic and the corresponding frequency chirp is quasi-linear in the central area of the pulses after PMs.

The standard single mode fiber (SSMF) is employed to compensate the up-chirp in the pulses, it can be seen that the chirp is nearly zero in the pulse duration.

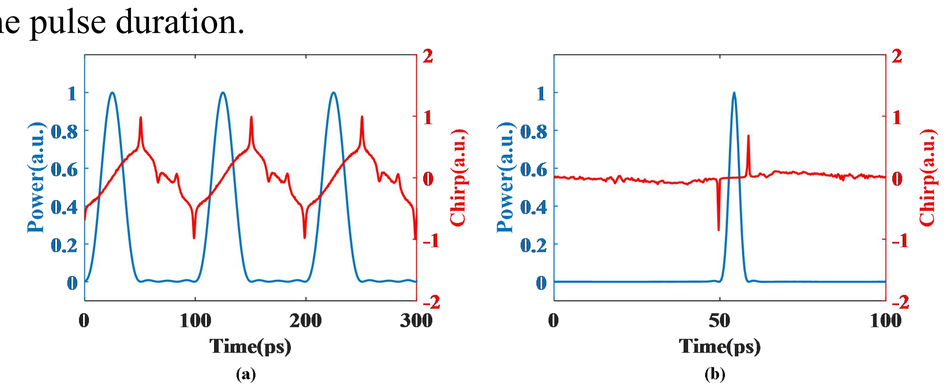

Figure 6. (a)temporal waveform (blue line), chirp (red line) after two PMs and (b)temporal waveform (blue line), chirp (red line) after SSMF.

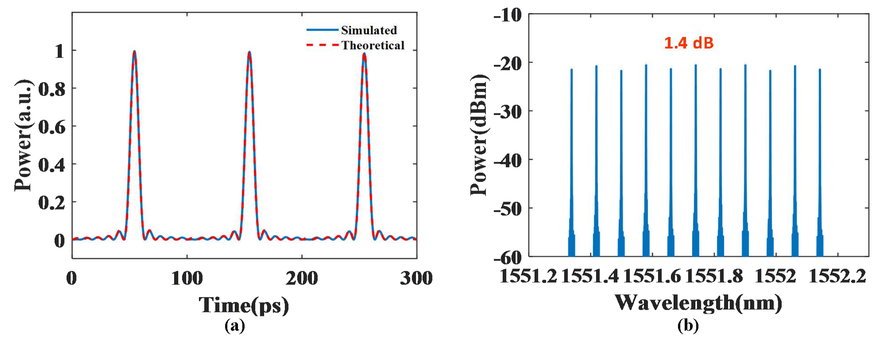

Figure 7. Nyquist pulses with FWHM of 8.1 ps, duty cycle of 8.1% using 11 comb lines.

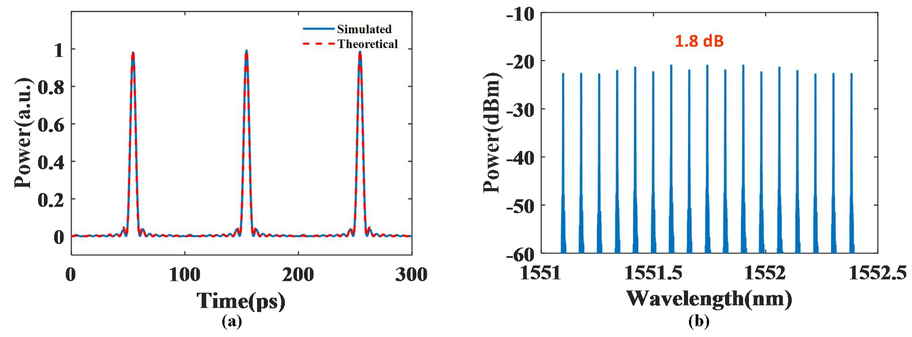

Figure 8. Nyquist pulses with FWHM of 5.4 ps, duty cycle of 5.4% using 17 comb lines.

The generated pulses are in good agreement with the ideal periodic Nyquist pulse train, and he power variations of 11-tone OFC and 17-tone OFC are less than 1.4 dB and 1.8 dB respectively.

IV. Conclusion

In conclusion, we have proposed and demonstrated a flexible and effective Nyquist pulses generator based on a DPMZM and subsequent spectrum broadening and quasi-linear chirp compensation. Nyquist pulses with a duty cycle of 21.6% are achieved experimentally using a single DPMZM. Also, Nyquist pulses with a duty cycle of 8.1% and 5.4% are obtained in the simulation of further study.