3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Terahertz Wireless Link Using Electro-optic Frequency Comb Generator and Direct Down-converter

Tadao Nagatsuma[(1)], Keita Toichi[(1)], Tsubasa Saijo[(1)], Ryo Koma[(2)], Ryo Igarashi[(2)], Kazutaka Hara[(2)], and Junichi Kani[(2)]
(1) Graduate School of Engineering Science, Osaka University, Toyonaka, Japan
(2) NTT Access Network Service Systems Laboratories, Yokosuka, Japan

There has been an increasing number of studies on terahertz (THz) communications in order to meet the demand for ultrahigh-speed wireless data transmission [1]. Use of photonics to generate and modulate THz carriers in the transmitter has proven to be superior to electronics-based approaches because of its inherent operation bandwidth. Two free-running lasers with a designated frequency difference, which corresponds to the carrier frequency generated by the photo-mixing with THz photodiodes, is widely used for proof-of-concept experiments, but they cannot be used for commercial systems, since long-term frequency stability is too poor to satisfy the radio regulations. Efficient way to stabilize the frequency is to use an electro-optic frequency comb (EOFC) generator, and two wavelength-of-lights are selected with an optical filter. As for the receiver, heterodyne and homodyne detection schemes are employed using electronic diode mixers pumped by local oscillator signals. Though the heterodyne detection is rather common because of its simplicity, it requires twice as large as the base-band (BB) or intermediate-frequency (IF) bandwidth compared to the homodyne detection or direct conversion.

In this paper, we study the combination of a frequency-stabilized transmitter using the EOFC generator and the direct conversion receiver as compared with previous studies [2-4] in Table 1. We apply the system to the 300-GHz-band wireless link with QPSK and 16QAM modulation formats to achieve the data rate of over 100 Gbit/s, and discuss the merit/demerit and limitation of the system.

Table 1. Positioning of approach of this study compared with previous ones.

Reference	Transmitter	Receiver
[2]	Free running lasers	Heterodyne
[3]	Free running lasers	Homodyne
[4]	EO frequency comb	Heterodyne
[This work]	**EO frequency comb**	**Homodyne**

Part of this work is supported by NICT Beyond 5G Promotion Project (00901).

1. T. Kürner *et al*. eds., "THz Communications: Paving the Way Towards Wireless Tbps," *Springer Series in Optical Sciences*, **234**, 2022.

2. V. K. Chinni *et al*., "Single-channel 100 Gbit/s Transmission using III-V UTC-PDs for Future IEEE 802.15.3d Wireless Links in the 300 GHz Band," *Electron. Lett*., 54, 10, pp. 638-640, March 2018.

3. I. Dan *et al*., "A 300-GHz Wirelss Link Employing a Photonic Transmitter and an Active Electronic Receiver With a Transmission Bandwidth of 54 GHz," *IEEE Trans. Terahertz Science Tech*., **10**, 3, pp. 271-281, May, 2020.

4. S. Jia *et al*., "0.4 THz Photonic-wireless Link with 106 Gbps Single Channel Bitrate," J. Lightw. Technol., **36**, 2, pp. 610-616, Jan. 2018.