

Development of a new approach for high-quality quadrupling frequency optical millimeter-wave signal generation without optical filter

Abstract

In this paper, we propose a new approach to generate quadrupling-frequency optical millimeter-wave (mm-wave) signal with carrier suppression by using two parallel Mach-Zehnder modulators (MZMs) in Radio-over-fiber (RoF) system. Among the numerous properties of this approach, the most important is that a filterless optical mm-wave at 60 GHz with an optical sideband suppression ratio (OSSR) as high as 40dB can be obtained when the extinction ratio of the MZM is 25 dB. Simplicity and cost-effectiveness have made this approach a compelling candidate for future wave-division-multiplexing RoF systems. Theoretical analysis is conducted to suppress the undesired optical sidebands for the high-quality generation of frequency quadrupling mm-wave signal. The simulation results show that a 60 GHz mm-wave is generated from a 15 GHz radio frequency (RF) oscillator with an OSSR as high as 40dB and an radio frequency spurious suppression ratio (RFSSR) exceeding 35 dB without any optical or electrical filter when the extinction ratio of the MZM is 25 dB. Furthermore, the effect of the non-ideal RF-driven voltage as well as the phase difference of RF-driven signals applied to the two MZMs on OSSR and RFSSR is discussed and analyzed. Finally, we establish a RoF system through simulation to verify the transmission performance of the proposed scheme. The Q-factor performance and eye patterns are given.

Keywords

Frequency quadrupling; Mach Zehnder modulator; Frequency quadrupling; Radio over fiber system; Optical millimeter-wave (mm-wave); Sideband suppression ratio