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Abstract

Optical fiber communication systems have played the most important role for transforming the information around world without degrading system performance. These systems utilize m-array quadrature amplitude modulation (mQAM) have been considered as an answer to upgrade fiber optic transmission systems. However, the performances of these systems are degraded and showed sensitivity to Nonlinear Phase Noise (NPN), which caused by Kerr nonlinearity. This work proposes a new method termed Phase-Conjugated Twin Waves (PCTWs) to enhance the efficiency of NPN in mQAM optical fiber communication systems .Indeed, phase-modulated optical communication systems that employ PCTWs are becoming attractive since they transfer high data rate for long transmission distance. First, twin waves are modulated with mQAM format and their envelopes are shaped using return-to-zero (RZ) encoder. Consequentially, RZ-mQAM twin signals are multiplexed and launched in an optical link. The received signals are synchronously combined to eliminate nonlinear impairments. To examine the efficiency enhancement, the proposed method is examined with single 4QAM channel and all-optical orthogonal frequency division multiplexing (AO-OFDM) systems. The results revealed that the NPN is considerably suppressed and the system performance is highly improved. Transmission distance of RZ-4QAM system with PCTWs technique is elongated by 100%, in comparison to 4QAM transmission. In addition, for RZ-4QAM AO-OFDM scheme with PCTWs, a signal-to-noise ratio (SNR) was improved by 5.7 dB and transmission length was also increased to 150% comparing with conventional 4QAM AO-OFDM scheme.

Keywords: Phase-Conjugated Twin Waves technique, All-optical OFDM system, Fiber nonlinearity and Modulation techniques.