Abstract

In long haul optical fiber links, Kerr nonlinearity imposes a major impairment that limits the performance of optical fiber communication (OFC) systems. In this thesis, nonlinear phase noise (NLPN) suppression is investigated for the coherent OFC system utilizing the phase conjugated twin-waves (PCTWs) technique. The PCTWs method is proposed to implement in two orthogonal dimensions, namely; spatial dimension (SD) and frequency dimension (FD). In SD system, the signal and its phase conjugated copy are modulated by 4-QAM or 16-QAM and multiplexed spatially through two identical fiber links. While with the FD system; twin waves that separated by 100 GHz spacing are multiplexed and sent through the same optical fiber link. At receiver, they are coherently superimposed to maximize the signal to-noise ratio (SNR). The analytical models which describe the influence of PCTWs on the cancellation of the phase noise in SD and FD systems are developed. The results expose that phase noise variance is substantially decreased when PCTWs technique is employed with both schemes. In addition, the numerical results show that the performances of both systems are considerably improved where the SNRs are raised by 4.5 dB and 2.5 dB for SD and FD systems, respectively. On the other hand, the mitigation efficacy of the PCTWs scheme is governed by the physical dimensions of propagation. The PCTWs technique in SD system can achieve better performance than that in FD system. The achievable transmission distance is extended by 77.8 % for SD system and 44.5% for FD system with 10^{-5} bit error ratio (BER).