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CANCELATION OF OPTICAL SYSTEMS IMPAIRMENTS. UNIVERSITY OF
TECHNOLOGY

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Abstract

High bit rates optical communication systems pose the challenge of their tolerance to linear and nonlinear fiber impairments. Coherent optical receivers using digital signal processing techniques can mitigate the fiber impairments in the optical transmission system. Recently, the use of electronic processing for the mitigation of signal distortion in optical communication has attracted increasing interest due to its low cost and size relative to alternative optical techniques and the potential for the integration of electronic processors with existing transceiver electronics.

In this work 40 Gb/s DP-QPSK system with coherent reception and DSP unit for optical fiber impairments compensation is proposed .The DSP unit processes the detected coherent DP-QPSK signal. The Chromatic Dispersion (CD) is compensated using a simple transversal digital filter and Polarization Mode Dispersion (PMD) is compensated using adaptive butterfly equalizer which is realized by applying the constant-modulus algorithm (CMA). A nonlinear compensator (NLC) is used for compensating the nonlinear effects based on the technique of multi-span back-propagation. A modified Viterbi-and-Viterbi phase estimation algorithm (working jointly on both polarizations) is then used to compensate for phase and frequency mismatch between the transmitter and local oscillator (LO). After the digital signal processing is complete, the signal is sent to the detector and decoder, and then to the BER test set for direct-error-counting.

*The presented system is designed and simulated using OptiSystem(2011) software interfaced with MATLAB software R2011a for implementing the DSP unit algorithms. The performance of each part of the system is analyzed by showing the optical spectrum, RF spectrum , electrical constellation diagrams, eye diagram and BER performance for different sampling rates and different bit rates . The system performance shows an obvious improvement with the increment of the sampling rate for OSNR 16 dB the BER is 10^{-4} for 4 samples per symbol while the BER is $5 * 10^{-4}$ for 2 samples per symbol . the simulation result shows that 40 G b/s system has better performance than 100 Gb/s for OSNR 16 dB the BER is 10^{-4} for 40 G b/s while the BER is $3 * 10^{-3}$ for 100 Gb/s.*

Keywords:Digital Signal Processing (DSP), Chromatic Dispersion (CD), Polarization Mode Dispersion (PMD), Constant-Modulus Algorithm (CMA),Nonlinear Compensator (NLC).