Laser phase noise effect and reduction in self- homodyne optical OFDM transmission system

ABSTRCT

We present a laser phase noise (PN) induced effect of a phase-modulation-to-intensity-modulation conversion noise and noise pedestals underneath each of the orthogonal frequency division multiplexing (OFDM) subcarriers in a selfcoherent optical OFDM transmission using a self-homodyne technique. We provide a statistical analysis on the received symbols using a histogram to demonstrate the effect of a phase rotation term and inter-subcarrier interference individually and collectively. The PN is then compensated using a simple time delay to realign the phase walk-off of the subcarriers relative to the carrier. Significant quadrature improvements of 6.82 dB using 5 MHz laser linewidth over a 720 km transmission length and 5.38 dB using 20 MHz over 240 km have been obtained with 16 quadrature amplitude modulation (QAM) over 15 GHz OFDM signal bandwidth. The technique also significantly reduced an optical-signal-to-noise ratio requirement at the bit error rate of $1 \times 10{-}3$ by 16.15 dB for 64-QAM over 160 km. With the delay, the system can tolerate three times the chromatic dispersion-length product..

Keyword: Laser sources; Optical signals; Phase noise; Signal processing; Systems design