ONS Problem Set 5

Wednesday, December 21, 2016

Problem 1: Generation of Advanced Modulation Formats

a) Describe the structure of a common inphase-quadrature (IQ) modulator. In which operation mode are the MZM operated? What is the advantage (disadvantage) of using an IQ modulator compared to dual-drive MZM modulator?

b) Define the electrical drive signals for the I- and Q-arm of the modulator that are required for a quadrature phase shift keying (QPSK) signal. How do the signals have to be adapted to generate a 16-state quadrature amplitude modulation (16QAM) signal? What is to be considered for a higher order modulation formats (e.g. 16QAM, 32QAM, 64QAM, …) in terms of the transfer function? Name and explain two ways to avoid the effect?

Problem 2: Self-Homodyne Detection

Self-homodyne detection refers to the reception of a coherently modulated carrier on a single-ended photodiode. Therefore, the modulated signal is transmitted along with its carrier on the same fiber

a) Describe how to practically transmit the carrier itself. Determine if the phase information of the optical signal can be extracted for self-homodyne detection.

b) Self-homodyne detection, besides being impeded by thermal noise is inherently affected by the signal-to-signal-interference. Derive the signal-to-interference-and-noise power ratio (SINR) for homodyne detection in dependence of the carrier-to-signal power ratio (CSPR).

c) The inherent noise-limitation for self-homodyne detection can be avoided using self-heterodyne (or single-sideband, SSB) schemes. Describe the principle, how a SSB or self-heterodyne signal can be generated using an IQ modulator.

For questions and suggestions on the ONS tutorial please contact:

Stefan Wolf, Bldg. 30.10, Room 1.23,
E-Mail: s.wolf@kit.edu

Denis Ganin, Bldg. 30.10, Room 2.23/1,
E-Mail: denis.ganin@kit.edu