

IMPLEMENTATION OF FIBER OPTICAL PARAMETRIC AMPLIFIER FOR DISTINGUISHING OF POLARIZATION MULTIPLEXED SIGNALS IN OPTICAL TRANSMISSION SYSTEMS

S. Olonkins, V. Bobrovs

Institute of Telecommunications, Riga Technical University, Riga, Latvia

E-mail: sergejs.olonkins@rtu.lv

Due to the variety of potential applications parametric amplification is positioned as the future leading technique for ultrafast all-optical signal processing in optical communication systems. Additionally to optical signal amplification, fiber optical parametric amplifiers (FOPAs) also offer a number of applications for all-optical signal processing, such as: wavelength conversion, 2R and 3R optical signal regeneration, and tunable dispersion compensation [1].

In [2] the authors have demonstrated one more additional application of FOPAs - the ability of binary polarization shift keying (PolSK) to intensity on-off keying (OOK) modulation format conversion. This application requires to use linearly polarized pumping radiation, the state of polarization (SOP) of which coincides with the SOP of the logical “1” component of the binary PolSK signal [2]. In this case the logical “1” component will receive maximal amplification, and the orthogonally polarized logical “0” will not get amplified. In this research the same principle is used to ensure one more additional application: distinguishing of two orthogonally polarized polarization multiplexed optical signals that are transmitted on the same wavelength in a two channel optical transmission system with non-return to zero (NRZ) OOK modulation format.

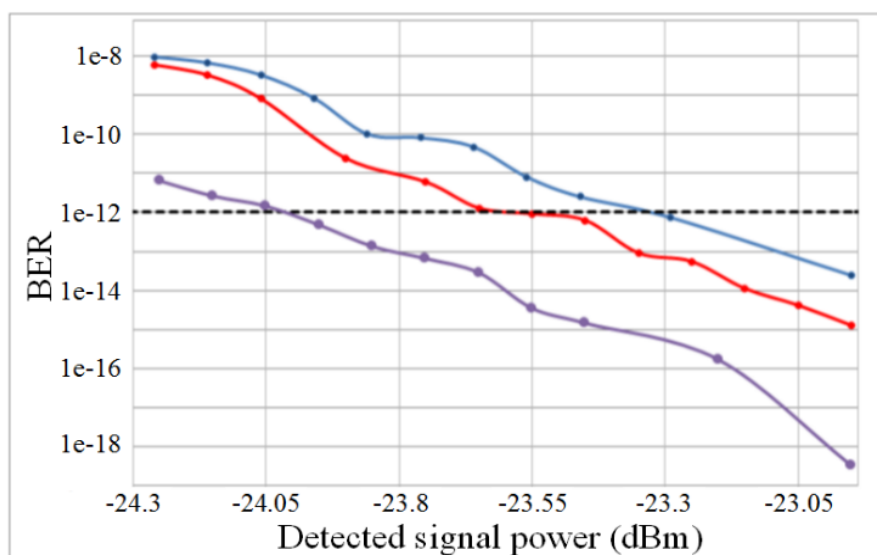


Fig.1. BER value dependence on the power of the detected signal in the ideal system (violet) and the 1st channel of the system with modulation format conversion configuration at carrier (blue) and idler (red) frequencies.

In the proposed solution after the signal is transmitted over 150 km of standard single-mode fiber it is divided among two branches. Each branch represents a receiver block, containing a FOPA and two receivers: one for the signal at carrier frequency, and one for detection of the generated idler spectral component. Based on the obtained results it was decided

that 530 mW 1553.9 nm pumping radiation should be used. Such amplifier configuration has ensured bit-error-rate (BER) below the 10^{-12} mark using as low pumping power as possible.

To assess the quality of the polarization demultiplexed optical signal the power of the amplified signal that was required to ensure a certain BER value was compared to an ideal single channel NRZ-OOK system, where no amplification is used. The obtained results are shown in Fig.1.

It was found that power penalty of 0.75 dB exists between the provided solution and an ideal NRZ-OOK system. For the idler this penalty was by 0.25 dB lower, due to the fact that the orthogonally polarized component was not involved in the process of parametric amplification and, therefore, was not transferred to the idler spectral component

References

- [1] T. Sylvestre et.al., "System Performance of Fiber Optical Amplifiers", *Fiber and Integrated Optics*, vol. 27, no.6, pp. 516-531, 2008.
- [2] S. Olonkins et al., "Binary PolSK to OOK modulation format conversion in single-pump FOPA for optical access networks," *Fiber Optics in Access Network (FOAN), 2013 4th International Workshop*, proceedings, pp.15-20, 2013.