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Multi-Impairment Compensation Based Deep Neural Networks for 16-QAM Coherent Optical Orthogonal Frequency Division Multiplexing System

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Abstract : In long-haul and high-speed optical transmission system, the orthogonal frequency division multiplexing (OFDM) signal suffers various linear and non-linear impairments. In recent years, researchers have proposed compensation schemes for specific impairment, and the effects are remarkable. However, different impairment compensation algorithms have caused an increase in transmission delay. With the widespread application of deep neural networks (DNN) in communication, multi-impairment compensation based on DNN will be a promising scheme. In this paper, we propose and apply DNN to compensate multi-impairment of 16-QAM coherent optical OFDM signal, thereby improving the performance of the transmission system. The trained DNN models are applied in the offline digital signal processing (DSP) module of the transmission system. The models can optimize the constellation mapping signals at the transmitter and compensate multi-impairment of the OFDM decoded signal at the receiver. Furthermore, the models reduce the peak to average power ratio (PAPR) of the transmitted OFDM signal and the bit error rate (BER) of the received signal. We verify the effectiveness of the proposed scheme for 16-QAM Coherent Optical OFDM signal and demonstrate and analyze transmission performance in different transmission scenarios. The experimental results show that the PAPR and BER of the transmission system are significantly reduced after using the trained DNN. It shows that the DNN with specific loss function and network structure can optimize the transmitted signal and learn the channel feature and compensate for multi-impairment in fiber transmission effectively.

Keywords : coherent optical OFDM, deep neural network, multi-impairment compensation, optical transmission
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