A novel training symbol structure design for transmitter IQ mismatch estimation and compensation in CO-OFDM system

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ABSTRACT

In this paper, a new training symbol structure consists of two adjacent training symbols is proposed to estimate transmitter in-phase/quadrature(IQ) mismatch and channel information in coherent optical orthogonal frequency division multiplexing (CO-OFDM) system. Each training symbol of the proposed scheme has two subsets which are mirror images of each other, and one subset values are set to zeros. Simulation in high speed gives the results that proved the proposed scheme increased the system performance.

NOVEL TRAINING SYMBOL STRUCTURE

Fig. 1 gives the block diagram of CO-OFDM system . Fig. 2 gives the proposed structure of the training symbols. These two training symbols at the beginning of a frame have two subsets: A , $\overline{A}$, and the $N/2$ *th* subcarrier is set as mirror. Data of subcarrier $\overline{A}$ is set as zero to eliminate the interference of the IQ mismatch in those mirror image subcarriers. The data in A subsets of two training symbols are random generated and could be different.

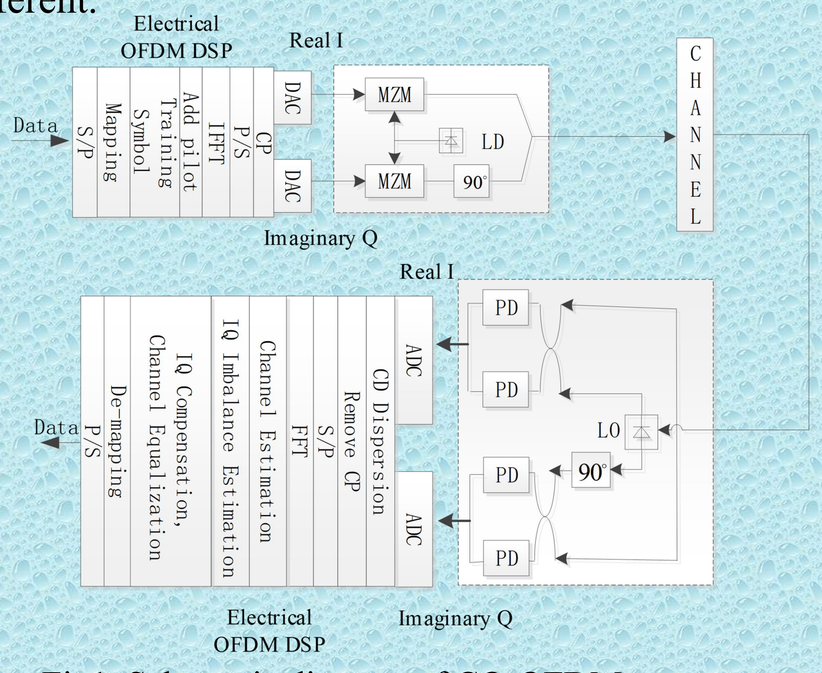

Fig1. Schematic diagram of CO-OFDM system.

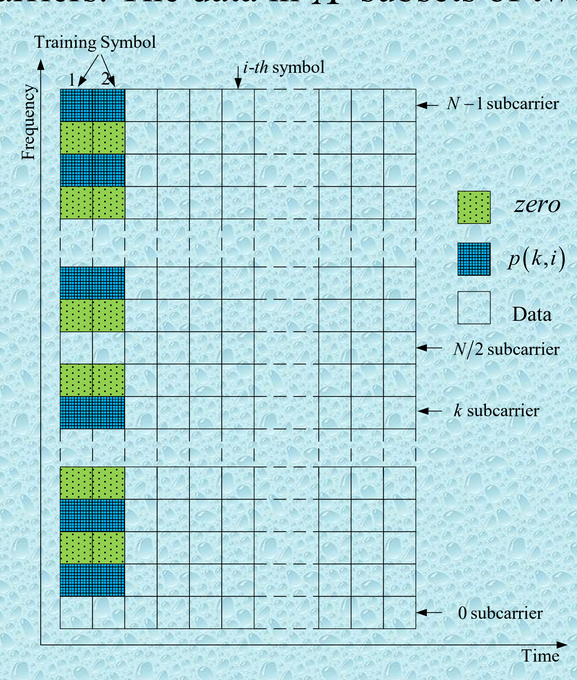

Fig2. The novel training symbol structure.

$$\begin{cases} Y(k,i)=H(k,i)p(k,i)+W(k,i), & k\in A \\ Y(k,i)=H(k,i)G\overline{p}^{*}(k,i)+W(k,i), & k\in \overline{A} \end{cases} \quad i=1,2 \qquad (1)$$

$$H(k,i)=Y(k,i)/p(k,i), \quad k\in A, i=1,2 \qquad (2)$$

$$G_i=\frac{Y(k,i)}{H(k,i)\overline{p}^{*}(k,i)}, \quad k\in \overline{A}, i=1,2 \qquad (3)$$

$$\begin{aligned} \hat{X}(k,i) &= f_{ZF}(k,i)Y(k,i)+g_{ZF}(k,i)\overline{Y}^{*}(k,i) \\ &= \frac{Y(k,i)}{H(k)\left(1-\left|\hat{G}\right|^2\right)}-\frac{\hat{G}\overline{Y}^{*}(k,i)}{\overline{H}^{*}(k)\left(1-\left|\hat{G}\right|^2\right)} \end{aligned} \qquad (4)$$

SIMULATION CONDITION AND RESULTS

OFDM

Transmission rate	Mapping	IFFT/FFT number	Valid subcarriers	CP length	OFDM symbol number
100Gb/s	QPSK	256	128	32	200

SSMF

Fiber link/loop	Wavelength	Attenuation	CD	DGD
80km	1550nm	0.2db/km	16.75ps/nm/km	0.2ps/km

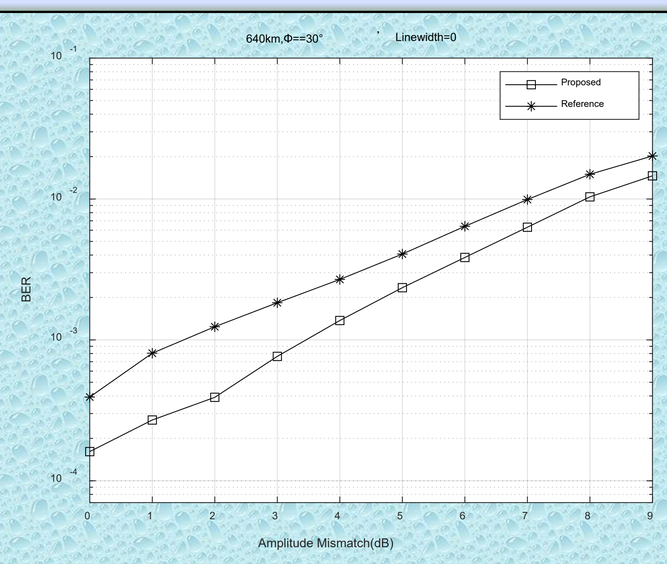

Fig3. The BER performance versus IQ amplitude mismatch at 100Gb/s.

Fig.3 gives the BER performance versus the IQ amplitude mismatch while the transmission length is 640km, the IQ phase mismatch is 30° and the transmission rate is 100Gb/s. From the figure we can see that the proposed method increased about 2dB tolerance of amplitude mismatch than the compared method.

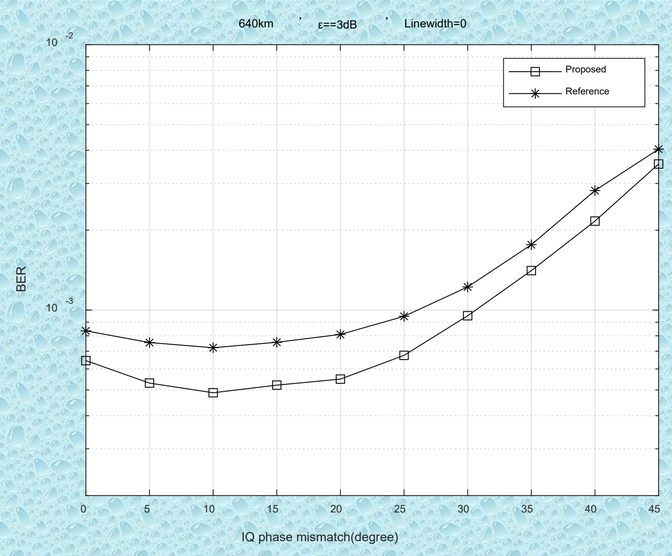

Fig4. The BER performance versus IQ phase mismatch at 100Gb/s.

Fig. 4 shows the BER performance versus IQ phase mismatch over 640km while the IQ amplitude mismatch is 3dB. The tolerance of phase mismatch can be improved about 5° by the proposed method than the compared method.

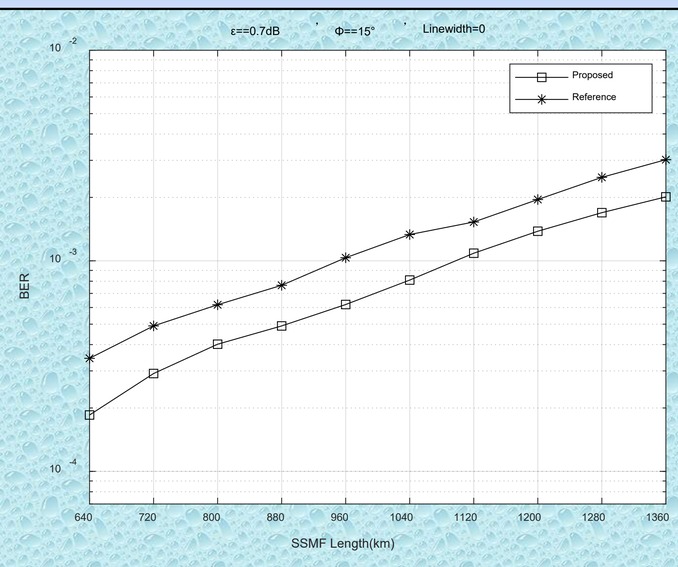

Fig5. The BER performance versus Transmission distance at 100Gb/s

Fig. 5 shows the BER performance at IQ mismatch $\varepsilon = 0.7$, $\phi = 15^\circ$ versus transmission distance with proposed and reference method. The transmission distance of the proposed method increases about 160km than reference method at 100Gb/s when BER is 1×10^{-3}.

CONCLUSIONS

In this paper, we proposed a novel training symbol structure to compensate the IQ mismatch for CO-OFDM system suit for higher transmission speed. Simulation results with different IQ amplitude and phase mismatch proved the proposed scheme has higher tolerance with IQ mismatch and more suitable for longer distance transmission.

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