Bit Error Rate Performance of 16 QAM in The Presence of Third-Order Intermodulation Distortion Component

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This paper presents bit error rate (BER) performance of 16 quadrature amplitude modulation (QAM) under third-order intermodulation distortion (IMD) component generated by power amplifier (PA) of transmitter. The fourth- and fifth-generation mobile communication system provide high-speed data transmission using QAM. It is known that the probability density function (PDF) of the third-order IMD component is different from that of Gaussian noise [1]. Transmitter needs to reduce power consumption for miniaturizing base station equipment. Therefore, PA also needs to operate around saturation output power for reducing power consumption. However, PA generates complicated IMD components in this case. Therefore, it is indispensable for evaluating QAM BER performance under IMD components by PA. This paper summarizes the computer simulation results of 16QAM BER performance as the first step and the future works.

The PDF of third-order IMD component is shown in [1]. The two-dimensional random sequence of the third-order IMD component is generated by the cube of Gaussian random sequence. The radio channel is static channel with Gaussian noise and the third-order IMD component. The two-dimensional random sequence of the third-order IMD components in in-phase and quadrature-phase (I/Q) plain concentrates around the origin point and distributes similar to cross image. This is reason why the cumulative distribution function of third-order IMD component is almost 60% around the random value of 0. Figure 1 shows the 16 QAM BER performance with the third-order IMD component and Gaussian noise. The horizontal and vertical axes show the signal to third-order IMD component power ratio (SIMR) and the 16 QAM BER. According to the results, the 16 QAM BER depends on the SIMR when the E_b/N_0 is greater than 15 dB. This is because the third-order IMD component dominates compared with Gaussian noise. On the other hand, the 16 QAM BER has floor performance when the E_b/N_0 is less than 10 dB. This is because Gaussian noise dominates compared with the third-order IMD component.
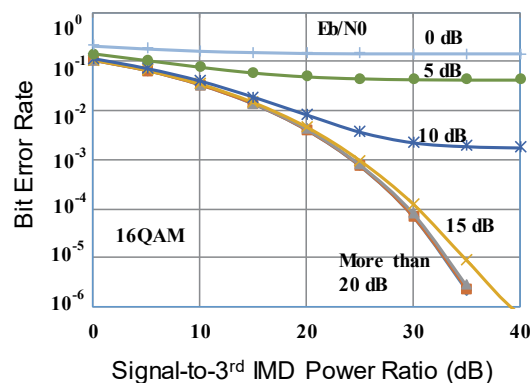

Figure 1. Computer simulation results of 16QAM BER performance in the presence of the third-order IMD components and Gaussian noise.

This paper presents the 16QAM BER performance under the third-order IMD component. The computer simulation results show that the third-order IMD component has effect the 16QAM BER performance. According to evaluate the transmission quality under IMD components, IMD component should take QAM BER performance evaluation into account. There is theoretical investigation for revealing the trade-off between the variance of the IMD component and that of Gaussian noise in the future.

References

[1] Y. Suzuki, S. Narahashi, and T. Nojima, "Bit Error Probability in the Presence of Third-Order Intermodulation Distortion Component from Power Amplifier of Different Mobile Systems," *IEEE Communication Letters*, **15**, 10, Oct. 2011, pp. 1041-1043, doi: 10.1109/LCOMM.2011.080811.110624.