Perspectives of Significant Improving of Noise Immunity in Modern Cellular Communications

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Abstract - **The simulation method of noise immunity improvement of radio signals with OQPSK and 8PSK at low signal-to-noise ratio is considered in this paper.**

Keywords – **8PSK, OQPSK, signal-to-noise ratio, AWGN, Simulink, Matlab.**

I. Introduction

In modern cellular communications one of the most actual problems is rational use of expensive frequency spectrum, because of the increasing of requirements for communication quality and data rates. This led to research in improving quality and capacity of radio channels without increasing the width of the frequency range. Thus the spectral-efficient modulation types QPSK, OQPSK and 8PSK, which are widely used in modern cellular communication systems such as CDMA and TETRA. Capacity of such systems is limited by interference between the users and channel fluctuations arising in the same communication channel. So, noise immunity is one of the key factors which limits the capacity of cellular system.

The method of improving noise immunity using modern types of signal modulation is described in this paper.

II. Main Part

In modern specialized literature [1,2] the concept of threshold signal-to-noise ratio (Eb/I_0 or SNR) is mentioned. According to this concept, the incidence of errors in the received signal (BER) is less or equal than the required value of threshold SNR (7-10 dB in existing communication systems). Equation (1) shows that the capacity (M) of cellular communication system is inversely proportional to SNR. Reducing this value, the increase of system's capacity, data rates or noise immunity can be reached.

$$M = \frac{\gamma G_A G_V G_p}{(E_b / I_0) H_0} \qquad (1)$$

In [3] the potential reduction of phase detector error caused by frequency unadjustment during synchronization stage is given. This method lies in the use of narrow-band filters that reduce the tremors in signal phase at high values of noise without changing the dynamic properties of the detector.

In this paper, adequate imitational models of CDMA cellular channel and TETRA radio channel were created and the noise immunity of OQPSK and 8PSK signals was investigated. During this work, it was determined the relationship between BER and SNR for classical phase detector and detector, modified by the system of narrowband proportional-integrated filters (PIF).

The results are shown in the according diagrams (Fig. 1).

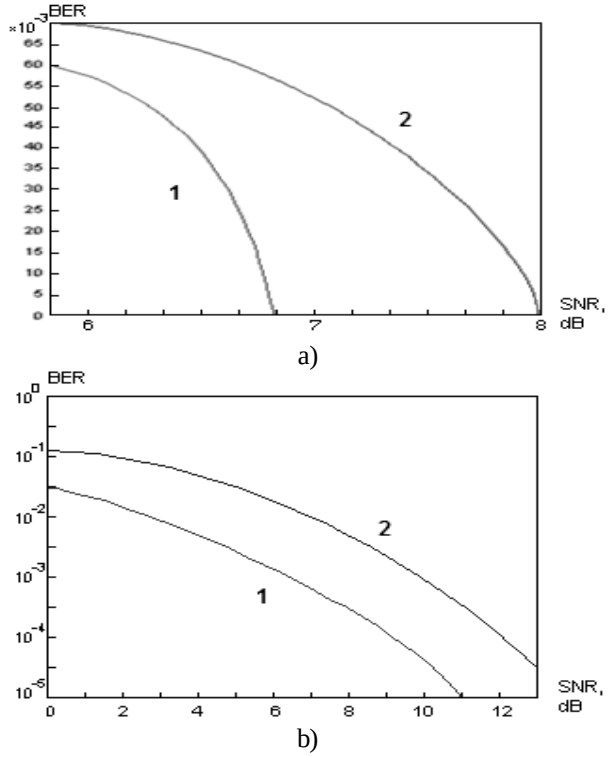

Fig.1. Diagram of dependence between BER and SNR in CDMA (a) and TETRA (b) communication channel using modified (1) and classic (2) phase detector.

As seen from the diagrams, with increasing noise level, the likelihood of errors in the classical detector increases dramatically, while as in the modified detector quality deteriorates much more slowly. It is important that curve #2 in both diagrams is adequate to BER-to-SNR curve in real systems [2]. This confirms the adequacy of imitational model of phase detector to its real analogues.

III. Conclusion

The effect of modification using narrowband filters before detector of OQPSK and 8PSK signals can significant improve noise immunity. Therefore application of this solution into existing cellular communication systems will reduce energy costs required to transmit signals, which will use the allocated frequency spectrum more efficiently.

References

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