ESTIMATION OF ADMISSIBLE VALUES OF SIZE MISTIMING FOR ALGORITHM OF RECEPTION ON A MAXIMUM OF LIKELIHOOD FUNCTION

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Abstract

This article describes the valid values of mistiming in synchronous multiple-access as described in [1]. The calculation was performed for the Gaussian monocycle monocycle and Manchester, which are basic for the analysis of such systems.

I. INTRODUCTION

As is known, in practice, perfect synchronization, in which time intervals (slots) for all customers the same, difficult to achieve, and sometimes even impossible. It is therefore of interest to calculate the allowable values of mistiming, in which the probability of erroneous reception is the same as in the case of "full" sync. As already noted, the analysis of these systems use two types of signals: Manchester monocycle and monocycle Gaussian [2]. Let us examine them in more detail.

II. A VALID VALUE MISTIMING FOR A SYSTEM OF MASS SERVICE WITH MANCHESTER MONOCYCLE

Consider the Manchester monocycle, it is described by the following formula [2, 3].

$$h(t)=\left\{A \;\; if \;\; 0<t<\frac{t_c}{2}, -A \;\; if \;\; \frac{t_c}{2}<t<t_c, 0 \;\; otherwise\right\}$$

where τ_c – the duration of half slot, A – amplitude of the monocycle.

Figure 1 shows the Manchester monocycle subject to "full" synchronization (black). Subject to mistiming monocycle can either keep (red) or ahead (green) monocycle with "full" sync.

Denote by E the energy of the signal. In accordance with the algorithm of admission to the maximum likelihood function [1] to the probability of error has not changed, the following inequality must be satisfied.

$$KE-KE' \le 0.5E,$$

where E' – the signal energy in the case of asynchronous systems, K – the number of subscribers.

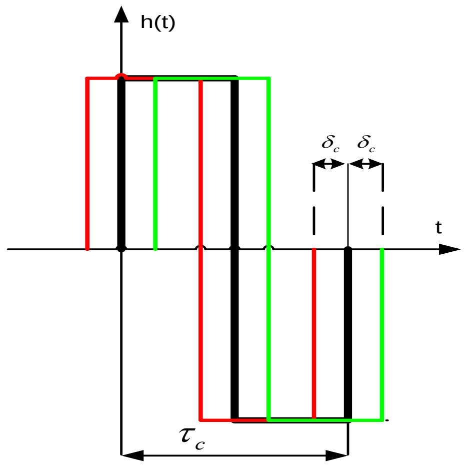

Fig. 1. Manchester monocycle; δ_c – the value of mistiming

It is obvious that $E' = E - \frac{\delta_c}{\tau_c}E$. Therefore $KE - KE\left(1-\frac{\delta_c}{\tau_c}\right) \le 0.5E$. Simplifying this expression, we obtain $\frac{\delta_c}{\tau_c} \le \frac{1}{2K}$.

What is the condition for an admissible mistiming subscribers.

Consider an example, suppose that the pulse duration is half slot. In real systems, the duration is 1 ns half slot [3 – 5]. We define the permissible value mistiming for 8 subscribers received formula.

The results of calculations showed that the permissible value was mistiming with what amounts to 6.25% from.

III. A VALID VALUE MISTIMING FOR A SYSTEM OF MASS SERVICE WITH A GAUSSIAN MONOCYCLE

Figure 2 shows the Gaussian monocycle subject to "full" synchronization (black) [2, 5]. Subject to mistiming monocycle can either keep (red) or ahead (green) monocycle with "full" sync.

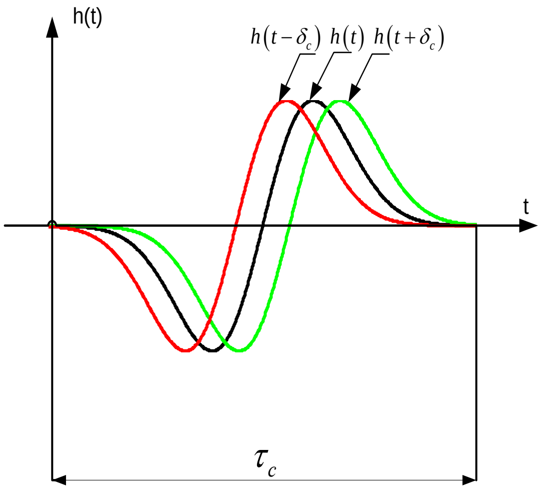

Fig. 2. Gaussian monocycle

It is similar to the first derivative of the Gaussian distribution function:

$$S(t) = A\frac{(2e)^{0.5}}{\tau}te^{-\left(\frac{t}{\tau}\right)^2},$$

where A – amplitude of the pulse, τ – a constant characterizing the damping. Let A, τ, equal to 1, since their values do not affect the test result. This function is symmetric about zero, and it is infinite, and therefore for the analysis of a synchronous system, this function has been modified for its existence in the time interval from zero to τ_c. We also consider the $\tau_{имп}$ – the duration of the pulse $(\tau_{имп} \le \tau_c)$.

Then the expression for S (t) takes the form

$$S(t) = (2e)^{0.5}\left(\frac{3(t-\tau_{имп})}{\tau_{имп}}\right)e^{\frac{-9(t-\tau_{имп})^2}{\tau_{имп}^2}}.$$

We find the area of the figure bounded on one side of the size τ_c and on the other $\tau_c - \delta_c$

$$\int_{\tau_c-\delta_c}^{\tau_c} S(t)dt = (2e)^{0.5}\int_{\tau_c-\delta_c}^{\tau_c}\left(\frac{3(t-\tau_{имп})}{\tau_{имп}}\right)e^{\frac{-9(t-\tau_{имп})^2}{\tau_{имп}^2}}dt.$$

We make the substitution variable $\psi = \frac{3(t-\tau_{имп})}{\tau_{имп}}$, whereas

$$\int_{\tau_c-\delta_c}^{\tau_c} S(t)dt = (2e)^{0.5}\int_{3\left(\frac{\tau_c-\delta_c-\tau_{имп}}{\tau_{имп}}\right)}^{3\left(\frac{\tau_c-\tau_{имп}}{\tau_{имп}}\right)}\psi e^{-\psi^2}d\psi$$

$$\int_{\tau_c-\delta_c}^{\tau_c} S(t)dt = \frac{(2e)^{0.5}}{2}\left(e^{-\left(3\left(\frac{\tau_c-\delta_c-\tau_{имп}}{\tau_{имп}}\right)\right)^2} - e^{-\left(3\left(\frac{\tau_c-\tau_{имп}}{\tau_{имп}}\right)\right)^2}\right)$$

As for the case of Manchester monocycle, like write a condition that must be satisfied that the probability of error has not changed.

$$KE - KE' \le 0.5E,$$

where $E' = E - E\frac{\int_{\tau_c-\delta_c}^{\tau_c} S(t)}{\tau_c}$.

Substituting E' we get

$$\frac{\frac{(2e)^{0.5}}{2}\left(e^{-\left(3\left(\frac{\tau_c-\delta_c-\tau_{имп}}{\tau_{имп}}\right)\right)^2} - e^{-\left(3\left(\frac{\tau_c-\tau_{имп}}{\tau_{имп}}\right)\right)^2}\right)}{\tau_c} \le \frac{1}{2K}$$

$$\frac{\delta_c}{\tau_c} \le \frac{-3\tau_{имп} + \tau_{имп}\left(\ln\left(\frac{\tau_c}{K(2e)^{0.5}} + e^{-\left(3\left(\frac{\tau_c-\tau_{имп}}{\tau_{имп}}\right)\right)^2}\right)\right)^{0.5} + 3\tau_c}{3\tau_c}$$

The resulting expression allows us to estimate the maximum possible value out of sync when used monocycle gauss.

Consider an example, suppose that the pulse duration is half slot.

As noted in real systems is half slot duration of 1 ns. You must define the permissible value out of sync for 8 subscribers received formula.

The results of calculations showed that the permissible value was out of sync $2.44\left(10^{-15}\right)$ c.

IV. CONCLUSION

In the present paper we obtain acceptable values of mistiming for the two cases when using the Gaussian monocycle monocycle and Manchester, which are fundamental to the analysis of such systems. The estimates obtained allow us to determine the limits of applicability of synchronous algorithms for data transmission systems in the UWB.of applicability of synchronous algorithms for data transmission systems in the UWB.

REFERENCES

[1] Algorithm of pulse position modulated signals reception in the channel with synchronous multiple access.” International Forum “Modern information society formation – problems, perspectives, innovation approaches”: Proceedings of the Forum. St.Petersburg, 30 May – 3 June / SUAI, SPb., 2011.

[2] Kamil Sh. Zigangirov THEORY OF CODE DIVISION MULTIPLE ACCESS COMMUNICATION, A JOHN WILEY & SONS, INC., PUBLICATION 2004 г, 400 стр.

[3] E. Favi, C. Charbon. Techniques for fully integrated intra-/inter-chip optical communication. In Design Automation Conference, 2008.

[4] T. Carusone. Future chip-to-chip interconnect technologies. In CMOS Emerging Technologies Spring Conference, 2009.

[5] S. S. B. Moore, C. Sellathamby and K. Iniewski. Chip to chip communications for terabit transmission rates. IEEE Asia Pacific Conference on Circuits and Systems, pages 1558 – 1561, 2008.