Phase Jitter Estimation In Radio Channels Of Telecommunication Systems

Gennadiy Bortnik, Mikola Vasylkivskyj

Annotation - **The reseach results of clock jitter influence on radiochannel parameters of telecommunication systems are observed. The phase instability of clock signal is used as summarized characteristic which evaluates the value of clock jitter of radiopath.**

Keywords - **phase jitter, radio channel, phase noise, telecommunication system.**

I. Introduction

Phase jitter of radiopath is the main factor which characterizes quality functioning of radiocommunication systems. The parameters of phase jitter determine restrictions stability of synchronization subsystem in telecommunication systems. Synchronization problem of clock pulses of telecommunication systems is solved by means of phase lock (PLL) [1]. The main parameter which characterizes the PLL accuracy of radiopath is random phase jitter [2]. The reasons of phase jitter appearance in radio channel are determinated and random types of noises and restrictions as well as the instability of operation threshold of logical components. Phase jitter estimation gives an opportunity to detect the reasons of its appearance and execute the estimation of bit errors values which characterize the operating quality of telecommunication system.

The purpose of the research is to evaluate the phase jitter of radio channel of telecommunication system. This facilitates the improvement of communication quality in telecommunication systems.

II. The Impact Analysis Of Phase Jitter Of Clock Signal On Radio Channel Characteristics Of Telecommunication System

The phase jitter of reference generator of clock frequency is the key parameter which determines spectrum width and shape of data signal of telecommunication system.

The analysis of phase jitter of radiopath should be done in account of phase noise and parasitic spectrum components of clock signal generator.

Root-mean-square deviation of phase jitter is:

$$s_e = \frac{s_j}{2pf_T} \qquad (1)$$

where s_j - root-mean-square deviation of signal phase of clock generator;

f_T - clock frequency.

In case of small values of phase noises of clock generator $(s_j << 1)$, phase jitter of radipath can be characterized by spectrum density of noise power which should be observed in reference to intensive low-frequency noises and thermal noise. The low-frequency component of phase noise, which determines phase jitter parameters, can be performed with the expression:

$$\Delta t_e(n) = \frac{\Delta j(n)}{2pf_T}, \qquad (2)$$

where $\Delta j(n) = j_0 + \frac{2p\Delta f}{f_Ò} n$ - phase deviation of discrete signal;

Δf - random deviation of sampling frequency;

j_0 - random initial phase.

The phase jitter of radiopath can be determined as the convolution of phase jitter of clock generator and pulse response of digital filter of transmission system:

$$e_{ФД.рк}(k) = \sum_n e_{ог}(n) \cdot h(n-k), \qquad (3)$$

where $h(n)$ - pulse response of digital filter;

$e_{ог}(n)$ - phase jitter of reference generator.

In case of noisy source of clock signal the given approach requires the use of additional process of window ranking in time and frequency domain. On the basis of this, final expression for phase noise dispersion as the criterion of phase jitter estimation on radio channel output can be written down:

$$e_{j.вих}(k) = s_j \sqrt{\sum_n |S(n)|^2 \cdot |h(n-k)|^2}, \qquad (4)$$

where s_j - thermal component dispersion of phase noise of heterodyne;

$S(n)$ - data signal.

The presence of significant phase jitter in radiopath results in the shift of input signal spectrum of telecommunication system.

IV. Conclusion

The use of window ranking in time and frequency domain of data signal as well as optimal structure of communication system are suggested for decreasing of radiopath phase jitter of telecommunication system at the expense of rejection of high-frequency components.

References

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Gennadiy Bortnik – Vinnitsa National Technical University, Khmelnitske Shose, 95, Vinnytsa, 21021, UKRAINE,
E-mail: vmvvin@rambler.ru