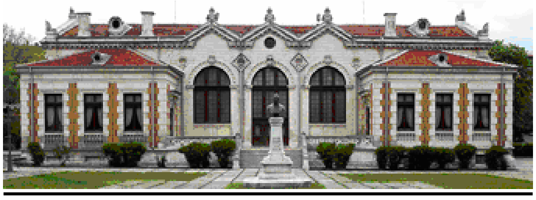

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ФИЛТРАЦИЯ НА ФАЗОМАНИПУЛИРАНИ ШУМОПОДОБНИ СИГНАЛИ В УСЛОВИЯ НА СТРУКТУРНА НЕОПРЕДЕЛЕНОСТ

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NON LINEAR FILTRATION OF PHASE MANIPULATED SIGNALS HAVING SPREAD SPECTRUM UNDER CONDITION OF STRUCTURAL INDEFINITENESS

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Abstract: *The paper discusses an approach about non linear filtration of phase manipulated signals having spread spectrum under condition of structural indefiniteness.*

Keywords: *phase manipulated signals, spread spectrum signals.*

Introduction

The features characteristic of radio communication systems with phase manipulated signals /PHMS/ are determined by the properties of these signals and their processing methods. Formation of PHMS is based on rigorous mathematical algorithms determining the structure of the signal generator, the form of signals formed and the desired characteristics of the system as a whole. Phase manipulated are called because regardless of deterministic character of formation in their spectral-correlation properties are similar to the implementation of a random process.

With regard to the problem, tasks related to structural uncertainty arising from such specific factors as the presence of intra-system interference and additive fluctuation noise of the receiver non additive time and phase distortion fluctuations of the delay, etc. At present time there are very few works devoted to adoption of PHMS under conditions of structural uncertainty. Using classical algorithms for processing of unknown signals representing realizations of random processes does not allow extracting all available information contained in PHMS. Therefore, development of methods for synthesis of optimal devices for the adoption of PHMS, taking into account a priori information about signal has a large theoretical and practical value, which defines the objective of this work.

Representation of the signal

Phase manipulated signal PHMS can be represented by the expression:

s(t) = b(t) cos[ωt + φ(t)],

where φ (t) is the random phase of the carrier, described by Vinerov random process, b(t) is a binary sequence of data, ω – the frequency of the harmonic carrier. For convenience we will assume that the amplitude of the signal unit. Then, if an $s(t)^*$ denote complex-conjugate of s(t) function, $s(t)s^*(t)=1$. The signal in this case can be represented as follows:

$$s(t) = s(t-\tau)\exp(j\omega\tau)\frac{E}{2\pi}\int_{-\infty}^{\infty}\phi(\tau,\Omega)\exp(-j\omega t)d\Omega$$

where E is the energy of the signal on the interval [0,T]; Φ(τ,Ω) – is the two-dimensional correlation function:

$$\phi(\tau,\Omega)=(1/E)\int_{-\infty}^{\infty}s(t)s^*(t-\tau)\exp(-j\Omega t)d\Omega=\left|\phi(\tau,\omega)\right|\exp[j.\arg\phi(\tau,\Omega)]$$

If the exponent is decomposed into a Taylor series, can be written:

$$s(t) = s(t-\tau)\frac{E}{2\pi}\exp(j\omega\tau)\int_{-\infty}^{\infty}\left|\phi(\Omega\tau)\right|\exp(-j\Omega t)d\Omega$$

Then the observable input of the receiver signal noise mixture, can be presented:

$$\xi(t)-g(t-\tau)sign\{\cos[\Omega_1 t+\varphi_1(t)]\}\cos[\omega t+\varphi(t)]+n(t)$$

,

where $\varphi_1(t)$ is the random phase of the clock speed $\Omega_1 = 2\pi/T$ is represented by Vinerov process. Evaluating the parameters φ(t) and $\varphi_1(t)$, which defines a problem in the field of nonlinear filtering of continuous random processes. Unknown sequence g(t-τ) may be described in two ways:

– through Markov process with set of transition intensities, or Markov chain.

Filtration of the parameters of PHMS

Filtration equations correspondding to the first case and the corresponding structure of the receiver containing the optimal nonlinear filter are discussed in work [1].

The second case leads to the following equations of the optimal nonlinear filtration:

$$\frac{d\varphi_1^*(t)}{dt}=\frac{\sigma_1^2}{2N_0}\xi(t)\mu(t)\cos(\omega t+\varphi^*).sign[\sin\Omega_1 t+\varphi_1^*]$$

$$\frac{d\varphi^*(t)}{dt}=\frac{\sigma^2}{2N_0}\xi(t)\mu_1(t)\sin(\omega t+\varphi^*);$$

Here $t\in[t_k,t_{k+1}]$;

$$\mu(t)=\mu_1(t-\tau+\varphi_1^*/\Omega_1;$$

$$\mu_1(t)=\mu_1(t)=th\left\{\int\xi(t)\cos(\omega t+\varphi^*)\right\},$$

N_0 is the noise spectral density. With σ_1^2 and σ_2^2 are marked the corresponding dispersions of assessments. The structural scheme of the device modelling above equations is shown in Figure 1.

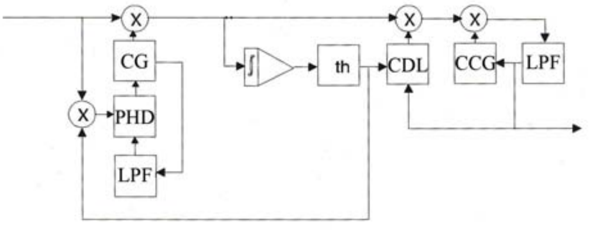

Fig.1

Entered in the figure marks are: CG – controlled generator; CCG – controlled clock generator; PHD – phase detector; LPF – low pass filter; CDL – controlled delay line, as discussed in [2].

Device whose block structure is shown in Figure 1 implements convolution between the detected signal and separated phase manipulated oscillation of clock speed.

Conclusion

The obtained results of the proposed work are a generalization of the principle autocorrelation adopting phases manipulated PHMS of unknown structure. As a general rule autocorrelation receiver is invariant with respect to frequency-shift keying spectrum signal, the proposed structural diagram of correlation receiver will be working with other signals with angular modulation.

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