ISSN 0735-2727, Radioelectronics and Communications Systems, 2008, Vol. 51, No. 2, pp. 97–100. © Allerton Press, Inc., 2008.
Original Russian Text © P.Yu. Kostenko, A.N. Barsukov, A.V. Antonov, K.S. Vasyuta, 2008, published in Izv. Vyssh. Uchebn. Zaved., Radioelektron., 2008, Vol. 51, No. 2, pp. 58–64.

Control Noise-Proof Recorery of Binary Information, Masked by Chaotic Oscillation of System with Delay

P. Yu. Kostenko, A. N. Barsukov, A. V. Antonov, and K. S. Vasyuta

Kharkov University VS, Kharkov, Ukraine

Received in final form June 11, 2007

Abstract—This paper deals with method of normalization of solution of information recovery from chaotic carrier distorted by channel noise task. Efficiency of the method is demonstrated on computational example of recovery of binary information, mixed with chaotic process, generated by dynamic Mackey-Glass system and proved by computations of correct recovery probability.

DOI: 10.3103/S0735272708020076

Discovery of chaotic oscillations in non-linear dynamic systems caused their utilization in information transmitting systems for solution a problem of confidential data transmit. Chaotic oscillation is similar to random process and has wide power spectrum.

Now there are widely known heuristic approaches to mentioned above task solution, the methods use phenomenon of self-synchronization of chaotic systems and sequences, formed by dynamic systems, and characterized by non-linear differential equations and representations correspondingly [1–3]. Essential drawback of such systems practical realization is strong (exponential) instability of information recovery procedure. This instability is determined by control noise presence and errors in definition of control parameters of receiving dynamic system. In this case self-synchronization is ineffective.

In paper [1] they carried out an analysis of secure connection methods, that did not require chaotic synchronization of two or several generators. It is considered mathematical models, described by non-linear Reussler differential equations (third order) and Mackey-Glass equations (first order) [1, 2]. Proposed mathematical models are also described by non-linear differential equations of corresponding order, but it is right only in case of control noise and interference absence. In the other case information recovery problem must be put as nonlinear filtration task, whose solution is intricate problem.

As a result of analysis, it is stated an important property of proposed systems. Under the decoding procedure, which is a part of receiver algorithm, there is no temporal error accumulation, expected in every chaotic systems with exponential divergence of neighbour trajectories, i.e. it is observed an asymptotic convergence of system. But serious drawback of the method is fast response to channel noise. The main source of decoded signal error is control differentiation in receiver. As a result, the output noise intensity is multiply greater than input noise. An order of differentiation growth leads to multiplier increase. For example, under the chaotic masking with utilization of Reussler dynamic systems the signal-noise ratio, that is ~1% at the receiver input and after decoding procedure, providing triple control differentiation, it can achieve $\sim 10^5$. At that time, differentiation time constant, used in differential procedure is reasonably small. To increase signal-noise ratio authors of mentioned above paper proposed to carry out a filtration of low-frequency components of receiver additive noise by low-frequency filter after every differentiation. This method allows to achieve a level of signal-noise ration (~10–12%) at the decoder output and moderate noise level (~5%) at receiver input.

Thus, due to troubles of practical realization of mentioned above methods of information transmitting through radiochannel using masking oscillations, that connected with essential influence of channel noise during differentiation process in receiver decoder, this method of security and confidentiality provide is not enough attractive.

There are at least two methods of output noise decrease. The first method lies in chaotic components number and/or their derivatives in representation of nonlinear dynamic system by equations of state, transmitted through communication channel, that allows to avoid repeated differentiation of controlled signal in receiver. The second way lies in application of low-frequency filtration of controlled signal with purpose to suppress noise gain in receiver, which use multiple differentiation operations. In this paper it is