Parametric modeling of periodically correlated random processes by their representation through stationary random processes

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Theoretical and experimental modeling results of periodically correlated random processes (PCRP) are presented. Representation through stationary random processes is used for construction of PCRP model. Dependence of PCRP modeling accuracy on parameters of correlation functions of stationary components is investigated. The offered algorithm of PCRP parametric modeling is suitable for generating signals with rhythmic structure.

Deterministic investigation principles of physical processes, at all advantages, do not allow to describe all complexity of the real phenomena. The use of the probabilistic approach to the analysis of the signals meeting in the nature and technics, enables to describe more widely changes of physical system, not being limited the description uniqueness. Random character of noise and distortions which take place during work of radio-engineering devices, demands use of probabilistic methods in theoretical radiotechnics problems. In the last time a random process became the basic mathematical model for signals description and noise and the distortions also. Probability theory, the theory of random processes, mathematical statistics, the decision-making theory are used as mathematical bases of statistical radiotechnics. Methods of statistical radiotechnics have the greatest efficiency and wide use in radar, radio communication, radiophysicist, seismology, and telemetry.

It is often necessary to model various signals with known characteristics at verification of devices and systems. It is useful to use model in the form of periodically correlated random processes (PCRP) [1, 2] for description of the physical systems signals which are characterized by repeatability and stochasticity. Signals models in the PCRP form allow to describe reliably physical systems properties taking into account regular, deterministic laws, and random distortions and the perturbations arising in system.

A number of effective parametric circuits is developed for modeling non-stationary time series. In particular, it is circuits of autoregress of integrated sliding average (ARISA) [3] and the circuit of periodic autoregress of sliding average (PARSA) [4]. It is necessary to notice, that the PARSA model is developed specially for modeling periodically non-stationary random processes. Parameters of PARSA model are periodic functions and the amount of parameters of this model increases when period value is large.

PCRP representation through the stationary permanently connected processes. Periodically correlated (in wide value) random process is a process \( \xi(t) \), which mean-value \( m_\xi(t) \) and correlation function \( b_\xi(t, u) \) are periodic functions of time with period \( T \). This period \( T \) is the correlativeivity period:

\[
m_\xi(t + T) = m_\xi(t), \quad b_\xi(t + T, u) = b_\xi(t, u).
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