ISSN 0735-2727, Radioelectronics and Communications Systems, 2008, Vol. 51, No. 7, pp. 396–399. © Allerton Press, Inc., 2008.
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A Model of Information Process for Algorithm of People Finding Behind Optically Opaque Barriers

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Received in final form March 1, 2007

Abstract—Spectral-correlation characteristics of random information processes are considered. These processes appear in distance probing and control systems, and caused by objects, slowly oscillating in comparison with carrier signal period and compared with precession observation period, separate parts oscillation or objects linear movement. It is proposed a method of mathematic formalization of model of an information process, caused by output signal of coherent Doppler locator. Characteristics of reflected from undisturbed human signals are researched. It is shown that of spectral correlations provide the best in point of view of maximal signal-to-noise ratio spectral components of periodically correlated process detection on a background of non-coherent interferences at fixed sample length. It is shown a possibility of proposed model to be used in algorithm of recognizing and identification of slow objects, including hidden behind opaque barriers, by means of radio-methods.

DOI: 10.3103/S0735272708070078

Mathematical description of models of processes, observed at the output of physical device, is a basis of each scientific method of signal processing. It is obvious that sampling frequency, observation interval and also further transformations and signal processing methods must be correspondent with properties of these processes. Process model, like arbitrary model on the whole, must satisfy, first of all, two fundamental and frequently conflicting conditions: required process description adequacy and sufficient simplicity for signal processing algorithms realization. Unnecessary details leads to intricate mathematical description and, as a result, to algorithmic complex realization even by means of current high-speed computers. From the other hand simplified signal and information process models result in partial loss of information about researched object, or in decision-making about impossibility of information about object obtain by selected method.

PROBLEM DEFINITION

Model of stationary process, more widely used in practice and described in papers [1–4] in details, is not always adequate in real information processes description. For example, in Doppler radar [5] the signal reflected from human body, carries information about his movement, his extremities movement relative to trunk and about his respiration and palpitation rate. Moreover this signal contains fluctuation noises and interferences, caused by instability of apparatus parts and units. The signatures of object, which can be used in recognition and identification algorithms, are respiration and palpitation rate at rest. It is obvious that information process model, related to these signs is a non-stationary process model. Among known non-stationary models it should be underlined three models classes, which can be applied for mentioned process description. In particular, they are processes with temporal modifying mean value [6]; processes with temporal modifying mean square value [7] and mixed processes [8]. The first class is an additive non-stationary class, the second is multiplicative non-stationary class, and the third is mixed non-stationary class. If we suppose that radiolocator operation is normal, i.e. frequencies of coherent heterodyne oscillators, thresholds and levels of limiters are stable in the information process observation interval, then mathematical expectation of this process is independent on time, hence, classes of additive non-stationary and additive-multiplicative non-stationary process are not suitable for considered process model construction.

Multiplicative model of non-stationary process can be considered as a stochastic oscillation, that is regular probability dependence, but it has repetition property (periods of palpitation and respiration). Thus, model of information process for algorithms of human recognition and identification behind optically opaque barriers is based on multiplicative non-stationary models class.