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ANALYSIS OF DETECTION EFFICIENCY OF SIGNALS DISCRETELY CODED IN FREQUENCY IN THE PRESENCE OF PASSIVE CLUTTER

V. Ya. Plyokin and Nguen Thang Khyng

Moscow Institute of Aviation Engineering, Russia

An expression is derived for the signal-to-noise ratio, in terms of power, at the output of the accumulator of the burst of signals discretely coded in frequency, and of composite signals discretely coded in frequency, against the passive clutter background. Several quality indices, characterizing the suppression of passive clutter in suppression devices, are defined. The detection characteristics are calculated for the case when the passive clutter is suppressed with the aid of different suppression devices. The calculation forms a basis for estimating the efficiency of detection of such signals.

In order to meet the requirements imposed on tactical parameters of modern radar systems, to improve the radar noise immunity and reticence of their operation, it is necessary to employ signals with a large base (composite signals). The used radar signal must have the indeterminacy function (IF) of the "button" type, i.e., allow for improvement of the radar energy characteristics, high resolution in delay and Doppler's frequency, and low level of side lobes in the pedestal domain of the three-dimensional body of IF. With this aim in mind, we suggest using the signals discretely coded in frequency (SDCF), and composite signals discretely coded in frequency (CSDCF), particularly, sequences of SDCF (SSDCF) and discrete composite frequency signals with frequency keying (DCSFK) [1].

In this work we determine the power signal-to-noise ratio at the output of the accumulator of a burst of SDCF (CSDCF) of a pulse coherent radar system. We also describe the calculation of several quality criteria characterizing the rate of suppression of passive clutter, and calculation of characteristics of SDCF (CSDCF) detection in the presence of passive (correlated) clutter.

Consider the block diagram of the detection device (Fig. 1). The compressing filter (CF) for SDCF operates under the condition of matched filtration in every frequency channel, i.e., at coherent processing of the partial pulses. Hence, the CF may include N band-pass filters (BPF), whose output signals are delayed in conformity with the frequency-time matrix of the signal, and are accumulated with regard to initial phases of the elementary radio pulses, where N is the SDCF dimensionality. Every BPF, shown in the block diagram, is matched to a single element of the signal, i.e., radio pulse with its frequency f_n, and has a bandwidth Δf equal to $1/T$, where T is the duration of an elementary pulse. The delay unit (DU) contains $(N - 1)$ delay lines, each providing the respective delay time. Between the BPF and DU sets, a controlled switch (CS) is introduced — to connect the filters' outputs to the inputs of delay lines used for setting up the appropriate frequency code of SDCF (CSDCF) in the adder. The control unit (CU) generates the controlling signals for CS in conformity to the frequency-time matrix of the used signal. Application of CU permits the processing of any SDCF and SSDCF with different codes of frequency and with the dimension N_s, not exceeding the number of bandpass filters N_f, by a single compressing filter. The signals from the output of delay lines are accumulated in the adder.

In the functional diagram of the detection channel, the CF output is connected to the passive clutter suppression device (SD) of the system of selection of moving targets (SMT). The main function of SD is to suppress the clutter to a maximum

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