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Estimation of Potential Efficiency of Interperiod Processing of Coherent Batch Radio Pulses against Background of Clutter in Pulse-Doppler Radars with Medium Frequency of Probing

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Abstract—The potential efficiency of optimal interperiod processing (IPP) of coherent batch radio pulses reflected from point air targets against the background of high-power clutter is analyzed during the radar operation in the pulse-Doppler mode with middle frequency of probing at ambiguous measurements of target range and velocity. This efficiency is compared with IPP efficiency during the radar operation in the coherent pulse mode. The analysis is performed at constant and variable probing intervals when the time span of the clutter source zone is both less and greater than the probing interval in pulse-Doppler radar, i.e. in the absence and presence of superposition of clutter from different range sections. The cases of complete match of parameters of clutter superposition are analyzed at different radial velocities of equipotent clutter layers, and also the cases of superposition of nonequipotent clutter layers, the powers of which are inversely proportional to the squared distance from their sources. In addition, the wobbling of intervals of signal probing is also taken into account.

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INTRODUCTION

Radars for the air space control and air traffic control solve their information tasks in the presence of interferences, in particular, masking the clutter representing hampering reflections of different physical nature. An example of their effect is shown on the PPI (plan position indicator) display of the 23-cm band operating radar (Fig. 1). It can be seen that a significant part of the screen area is flared by clutter and against the background of these flares it is not practically feasible to detect a weaker useful signal from the air target without special measures.

Huge attention in scientific and technical literature is devoted to the radar protection from clutter, primarily, to the methods of high-speed moving target indicator (MTI) [1–18]. They are routinely applied in radars of different kinds and different assignments, in particular:

– coherent pulse (CP) surveillance radars with low frequency of probing (LFP) at unambiguous measurements of range and ambiguous measurements of target velocity [1, 3–10, 16, 18]. They are also known as MTI radars [3–6];

– more expensive and complex [4] pulse-Doppler (PD) on-board (aircraft) and ground-based radars with middle frequency of probing (MFP) at ambiguous measurements of target range and velocity or with high frequency of probing (HFP) at ambiguous measurements of target range and unambiguous measurements of target velocity [1, 5–7, 15, 17].

The introduction of PD mode was aimed at enhancing the efficiency of MTI methods [3, 4, 7], especially in on-board aircraft radars against the background of high-power reflections from the Earth [3, 5–7]. This opportunity is related, in particular, to the fact that PD mode as compared with CP mode reduces the number of blind velocity zones at MFP or they are not present altogether at HFP, and also increases the number of pulses in useful signal batch (packet). Therefore, in the presence of clutter, where the length of the area of

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