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Estimation of Spatial Weight Vector Fixation Interval for Sequential Space-Time Signal Processing against the Background of Combined Interferences

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Abstract—We consider separate space-time adaptive signal processing against the background of combined interferences, which involves the fixation of weight vector of spatial signal processing against the background of noise interferences for the time of adaptive interperiod signal processing against the background of clutter. By means of mathematical modeling and hydroacoustic simulation the fixation interval is estimated, which keeps in allowable limits the losses in quality of noise interferences suppression.

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INTRODUCTION

Operation in case of influence of noise and clutter (combined interference) is typical mode for the most of radars [1–3]. Noise (direct noise) interference (NI) is created by sources of independent continuous noise interference, which are located in the radar antenna distant zone and considered to be point ones by distance and angular coordinates. Passive interference (clutter, CL) is generated by reflection of the radar probing signal itself from local objects, hydrometeors, dipoles, etc.

Increase of efficiency of signal processing in case of influence of combined interferences is considered in many local and foreign papers [1–11]. There are much attention is paid to simplification of enough complex optimal space-time processing, in general case it is not divided on sequential space and time ones [1, 6–10].

One of trends of such simplification is denial of mutual (parallel) processing for benefit of sequential one, whose each step provides protection from one component of total (combined) interference. Frequently space (angular) selection against the background of NI precedes to time (interperiod) signals processing against the background of clutter. For efficient angular selection weighting vector of space processing should be calculated with learning sample, generated by just NI. It is formed, in particular, at time points, before radar radiation, or at space positions, which are free from passive reflectors. It can be obtained in specially introduced receiving channels, mistuned by frequency on a value, greater than probing signals spectrum width [9, 12].

Due to finite volume of available learning sample, space processing vector, obtained on its basis of is random and hence it is different in adjacent time probing intervals, during which it is interperiod processing against the background of clutter is carried out. To prevent interperiod decorrelation, generated by such randomness, which results in decrease of its compensation efficiency, the space weighting vector on the interval of interperiod processing is supposed fixed or “frozen” [6, 12, 13].

It is obvious it can result in decrease of NI protection efficiency, since during fixation time a position of NI sources with regard to the radar position is changed due to antenna rotation and movement of NI sources; for this position “frozen” space weighting vector (SWV) does not provide efficient NI suppress, i.e. it becomes “aging”.

Therefore fixation time of SWV must be selected on a basis of compromise, considering necessity to provide clutter protection without essential loss of NI protection.

In paragraph 1 we consider in brief mutual space-time processing of a signal against the background of combined interference, and also simplified system of separate spatial and time adaptive processing. The results of estimation of admissible SWV fixation interval with method of mathematical modelling and hydroacoustic simulation are represented in paragraphs 2 and 3, correspondingly. In conclusion we state results of theoretical and experimental research and give some practical recommendations.