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Adaptive Control of Distribution of the Energy and Time Resource of Radar Systems with Phased Antenna Array

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Abstract—The paper considers principles of construction of algorithms for adaptive control of resource distribution of radar systems with phased antenna array (PAA) in real time. An approach to selection of strategy of distribution of a limited resource of RS in complex operation conditions is proposed. The paper includes results of inquiry in efficiency of the suggested algorithms obtained with the aid of an imitative model.

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The present-day situation in the zone of radar responsibility is characterized with availability of a large number of targets (high-velocity, maneuvering, barely visible) and of interference of natural and man-made origin.

The remarkable potentialities of radar systems (RS), using phased antenna arrays with electronic control of RPA beam (RPA—radiation pattern of antenna), permit to perform simultaneously several time-shared functions. However, when dealing with these tasks, we must remember about inevitable limitations on the energy and time resources of RS, and about various requirements to accuracy characteristics of tracking and periodicity of yielding the information to the users.

Effectiveness of a multifunctional RS depends on its control system, and optimization of this system is always a pressing problem.

The optimality criterion for the problem with complex target situation in the presence of interference is a maximum number of targets, tracked with a preset accuracy and periodicity, with the possibility of detecting new targets in certain zones of surveillance with a preset probability.

Note that practical treatment of the optimization problem in the dynamic mode of RS operation presents considerable difficulties because of a large number of parameters to be optimized.

The purpose of this work is to propose basic principles of adaptive control of operation of RS with PAA, and to formulate a strategy for distribution of RS resources during its operation—within each functional mode, and when changing from one function to another. We also give an example of practical algorithm of adaptive control of different functions of a RS with immovable PAA under hard tactical conditions.

Creation of the feasible adaptive algorithm for management of a multifunctional RS (MRS) is based on the widely used principle of optimal control of complex systems [1–3] under dynamic variations of external impacts.

The fundamental principle, permitting to break the problem of many-dimensional control into separate components, is the principle of hierarchical organization of optimal control [4].

The hierarchical structure, as applied to the task of control of MRS modes of operation, presented in Fig. 1. The structure is characterized by several levels [5].

The highest level of operative situation control is performed with account of all data concerning tactical situation and of tactical tasks existing at the moment.

The second level is related to distribution of resources between functional modes with regard to prescribed limitations (the budget of time and energy).

At *the third level* we resolve the problem of optimal distribution of resources in each functional mode of operation within the share allocated by the higher level.

And, eventually, at *the lowest level* we perform straightforward control of RS parameters in order to resolve the task of target detection and to measure coordinates of blips in the sounded direction. The