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V.M. Lishchenko, B. A. Lisogorsky, H.V. Khudov, doctor of Technical Sciences
(Kharkiv Ivan Kozhedub National Air Force University, Ukraine)

Suggesting for determining an object's space coordinates in a small base multi-radar system

The work analyses the disadvantages and advantages of existing multi-position radar detection systems for airborne objects. In order to increase the range of detection of low-visibility and small-sized air objects, it is proposed to use several one-type of surveillance radar and to combine them into a low-base synchronous multi-radar system. In such a system a higher value of the ratio of the useful signal to noise is achieved.

From the analysis of the experience of armed conflicts in recent years, especially in the network wars, it is known that one of the trends in the development of modern air attack means is increasing the number of small-sized air objects [1]. The main difficulty in surveillance in such conditions is the detection of airborne objects belonging to the class of unmanned aerial vehicles with small radar cross section [2].

The main trends in the development of modern surveillance facilities for detecting small-sized air objects are a qualitative increase in the in formativeness and reliability of the interpretation of radar reflection, shortening the time of inspection, researching and introducing new technologies [2]. The effectiveness of radar surveillance and informative in the processing of primary information can be increased by a more optimal using the system energy. This is achieved by combining individual radars into a single multi-radar system [2, 3].

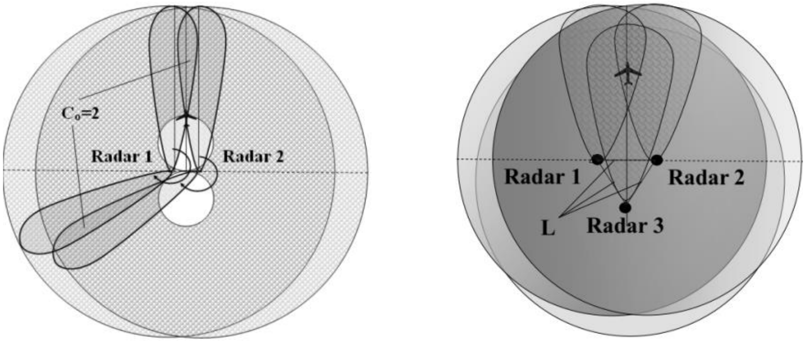
The goal of the work is to analyse the possibility of using additional system effects when combining observation radars into a synchronous multi-radar system. The system effects are considered as the effects that obtained in the multi-radar system but not in one radar.

The development of information technology, the use of special high-speed processors in signal processing of signals and a new element base extends the functionality of surveillance facilities. This enables the implementation of new solutions to improve the quality of detection of airborne objects. It is known [2] that the available surveillance system requires increasing number of radars and compacting of the radar tracking field in the case of a complication of the airspace. This is due to the introduction of additional radars into a certain area. In this area, a larger coefficient of multiplicity of overlapping detection zones is created and a lower bound for the detection of airborne objects is reduced. However, the energy of the entire radar system is not fully used. Each separate radar receives only its echo. In the work, available survey radars are suggested combining to improve the detection of airborne objects.

Multi-radar system is a system that uses more than one radar source and has the capability to process and display integral data from all involved radar sources. Synchronous multi-radar system with spatial coherence with the integration of information at the level of primary processing of echo signals has significant advantages. The potential resultant of radar information that can be obtained in such system is more accurate than that of monostatic radar which is not integrated into the system [2].

To simplify the assessment of the potentialities of the multi-radar system, assume that the coordinates of the aircrafts on all radars that form the multi-radar system are measured at the same time. In practice, this is realized by performing a synchronous space review.

The analysis will be carried out for a spatially-coherent multi-radar system of single-type radars, which are spaced at a distance L represented in Fig. 1



a) b)

Fig. 1. Spatially-distributed synchronous low-base multi-radar system:
a) two-position; b) three-position

Two radars with a narrow antenna beam forms an area with synchronous rotation. There is a coefficient of overlap in this area equal to $C_0 = 2$ Fig. 1(a). The area depends on the size of the base and the width of the antenna beam of each radar.

The multi-radar system parameters were calculated Fig. 2.

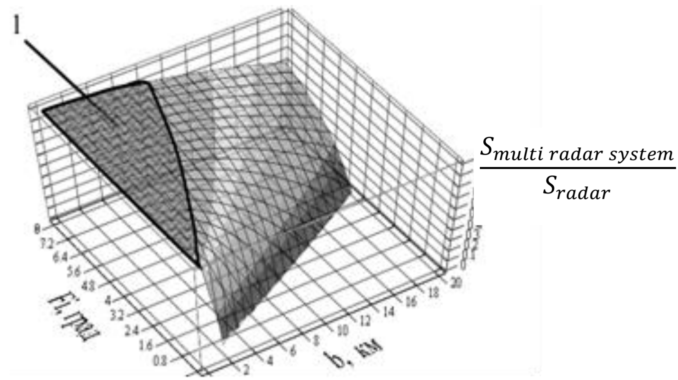


Fig. 2. Calculating of parameters of low-base multi-radar system

It has been shown that the best possibilities for using multiposition radar techniques are provided if the radars are located at a distance of no more than 2 km this is shown as area 1 Fig 2. In addition, this multi-radar system provides the capability to use system effects. Range-gauge method was used to determine the altitude of air objects. The using of this method enables obtaining an accurate detection of the target coordinates. In this case, the accuracy of determining the angular coordinates of each radar does not change. This enables to using regular mode radar which is not designed to calculate the altitude of the airspace for insuring high-accuracy combat information.

Conclusion

The conclusions according to the results of the analysis as follows: the accuracy of determining the range to the object in the multi-radar system depends on: angular measurement errors, values of the base, position of the target in the zone relative to the normal to the base and distance to the target.

References

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