THE DETERMINATION OF THE PARAMETERS OF THE NECESSARY DETECTABLE TARGETS IN THE RADIO TECHNICAL SURVEILLANCE SYSTEMS.

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SUMMARY

The article deals with the peculiarities of various types of target detection with the use of radar stations in the organization of radio technical observation in the Navy and the methods have been proposed to determine some parameters for detecting a target during combat operations.

Key words: systems of radio engineering observation, radar stations observation zone, area of coverage, antenna devices.

Introduction

In modern times, the requirements for observation of the surface condition of seas and the systems controlling it have been increased. Currently, surface surveillance condition at seas and its control systems are used in oil and gas production areas in the fight against terrorism and smuggling. Everything is tended to the use of these systems in surviving people at sea and in monitoring the environmental status of the coastal area. To accomplish the following tasks, radiolocation means are claimed to carry out necessary observation.

The distance impact sphere in radar systems, indeterminable precision of coordinates and speed, aptitude for solution concerning distance and speed depends on parameters of a sensor signal. To gain these objects, double-coordinated radar stations (RADAR), conducting circle observation with main sensor signals should be applied to. Like a sensor signal simple rectangular impulses are used by short duration and large depth. These stations are able to operate in independent and complex conditions[1] located on coasts, islands, as well as ships.

The analysis of various kinds of parameters radar systems shows that, the parameters of receiving and transmitting antenna, depending on its functional purposes, define its processing and description of information, management of working rate of radar systems, intercommunication with civilian ships and organizations, as well as exchange of information. The work is being carried out in the sphere of decrease of overall dimensions of constructions and improvement of the following parameters giving application of new technology.

Observation zones

Significant expansion of military zones in the sea in which modern warships could use their weapons, is characterized by the reduction of time for solution of military issues, the fight for 'first fire' and the massive of target destruction means. In this case, many resources of the ship, including the time allotted for detection and accompany of an enemy, the use of fire, decision-making and missile orientation, the radiation power of radar stations become completely deficit.

Specified parameters clearly indicate the importance of emergency and decisive role of ship RADAR in the modern war conditions in the sea. Ship RADAR are the main means in detection of air and surface targets, the determination of direction of movement and speed, as well as supplying use of rocket and artillery weapons. Different kinds of RADAR are used in the arsenal of modern rocket carrier cruise ships for various tactical purposes[2]. Observation zone is appointed by the limits of minimum and maximum observation sectors of the distance. The sectors of observation zone of the radiolocation are shown in the picture 1.

In picture 1 detection zones determined by maximal and reliable distance detection occur as a result of implementation of radio technical observation means in space or sector view.
For reliable identification of targets in the radiolocation exposure zone, the each point of this spatial zone should be periodically irradiated by sent signals. For this purpose, radiolocation vision is performed in the given spatial zone.

Vision at distance leads to target detection within the limits of antenna ray and to measuring distance to it. For the vision of all distance intervals, if we accept the required minimal time for providing probability of necessary detection of a target and not small number of impulses (Nj) reflected from it, then the period of vision at distance (Tvis.d) could be defined by the following formula

$$T_{vis} = N_j \frac{2d_{max}}{c}$$

Due to the fact that the wave speed is very high, vision at distance occurs at a relatively small time interval. But vision at distance is carried out by means of an electronic device operating in active mode and applied in radio range meters, radiolocation explosives, aircraftaltitude meters and in other means (there is no big importance of direct ion to a target).

In most cases, to see space, antenna orientation diagram should be led to a wider field. Because of this, vision on the direction should be within the limits of given field. The following are the basic requirements for radar vision systems notto let the targets pass during vision, to provide given tactical parameters in RADAR (ability of distinction and accuracy according to vision and angle coordinates), he simplicity of a device, relevant sizes and weight, as well as a high reliability of the system providing vision.

In order to provide such complicated and controversial requirements, projected RADAR-s can be mono-ray and multi-rayed. In mono-ray RADAR an antenna device generates only one ray and moves in space according to implemented vision method. Therefore, it is impossible to perform instant vision in such RADAR. In comparison with multi-rayed RADAR where the antenna device generates more than one ray, due to the formation of a large number of rays, at mono-rayed RADAR, the time of space vision is relatively less. It is possible to carry out instant or parallel vision in space with help of multi-ray RADAR. The following features are the basis of radar vision methods:

According to the number of rays formed by the vision system RADAR –s are mono-ray and multi-ray according to the number of space satellites (rotation of the ray formed by antenna device).

It should be taken into account here, that the signals generated by the waves reflected from various target which are located at the same distance from reception center, are influencing on an input of the receiver at any given moment The reception of the reflected radio waves by an antenna is carried out within a certain spatial angle ΔΩ. For evaluating this spatial angle, two flat angles Δα and Δβ located on its interaction perpendicular cuts can be used.
The value of flat angles $\Delta \alpha$ and $\Delta \beta$ is determined by radio $\lambda/d$, here $\lambda$ - wave length, $d$ - antenna dimensions on the appropriate cut.

Thus, the currents in antenna output are generated due to electrical and magnetical currents reverberated by the wave placed in distance $R$ from the antenna and fallen on rectangular area with linear dimensions $R\Delta \alpha \cdot R\Delta \beta$. The angles $\Delta \alpha$ and $\Delta \beta$ together with them form angle minute for large radiolocation stations. This value is equal to $\lambda/d (3 \div 5) 10^{-3}$ value of ratio. The dimensions of rectangular area are within the limits of 400-600 m for values shown in the distance 50 km from antenna. This sample concerns huge and rare antennae. As regards other antennae operated in santimeter diapazon, $\lambda/d$ ratio is within the limits of approximately $(3 \div 5)10^{-2}$ i.e. one power of given examples is bad. If the optical diameter is 1 sm, then sought-for ratio is within the limit of $10^{-5}$ and for this reason the dimensions of viewing area are principally different for optics. It should be noted that all objects located in one direction within the limits of $ct/2$ distance, are accepted as one object by an observer, here $c$ - lightening speed, $\tau$ is duration of sensing impulse. To clarify it, let’s look at numerical calculation of this quantity.

The duration of sensing impulse for “Simple” radio locator is within the limit of $\tau = 1 mks$. In this case, $\frac{ct}{2} = 150 m$, - is rather large value.

The parallelepiped with dimensions $R\Delta \alpha \cdot R\Delta \beta \cdot ct/2$ is called distinctive volume and distinctive element. All objects inside this parallelepiped are accepted as one target.

The decrease of distinctive volume, i.e. the problem of improvement of distinctive capability is a main problem of radiolocation. But even within constant distinctive element, the additional facilities are available for improvement of detection of radiolocation targets located in it. The polarization type which has enough efficiency to improve distinctive capabilities can be displayed. They have the following essence. As far as the polarization of irradiated radio wave changes, the power of reflected radio wave changes too. It is clear that such polarization type could be chosen for constantly sensing radio waves, so that ratio of radio wave powers reflected by applied target and background objects located in the distinctive volume would be maximum. Theoretical reports and experimental researches show that for many occasions, it is possible to increase radiolocation contrast 5-8 dB, in some cases 20 dB and much more.

The determination of the parameters of the necessary detectable targets

So far, according to radar stations, immutable targetshave been mentioned. During their movement, the reflected signal has different frequency according to a dual signal. This difference is proportional to the ratio of the target speed to the wavelength of the radial organizer. (Picture 3).
To organize the application of radio technical surveillance on ships, some of the following actions should be taken. It means that the organization of observation on surface ships depends on the tasks that the ship carries out, lack of observation power and facilities, sailing and vision conditions and the options of sudden enemy attack from any directions should be identified. Study of military training methods, the analysis of development level of modern weapons, as well as the experience of military specialists provide the basis that the organization of sudden attack, accuracy of movement and high speed of operations form the base of military activities. Acceptance of results of active means by the leadership and giving orders to the executives refers to the requirements for management systems in combat activities as soon as possible.

These requirements are very important during organization of radio technical surveillance on ships. While calculating \( D_z \) air targets for fighter targeting RADAR, enemy aircraft should be detected from certain distance to provide effective use of our fighters on time. There are some targeting options for fighters that have crossing courses \([2]\) and rear hemisphere shape. One of them is a rear hemisphere option which takes much time is a main issue of this case. From the points \( G_0 \) and \( h_0 \) happens our approaching to enemy aircraft. To reach zenith fire of enemy aircraft, it takes a certain amount of time for conducting the combat and flying the fighters.

\[
t_{\Sigma} = t_{\text{det}} + t_{\text{time}} + t_{\text{con}} + t_{\text{turn}} (2)
\]

- here: \( t_{\text{det}} \) – time spent for enemy detection, recognizing, classification and report; \( t_{\text{time}} \) – appointed time for element of target movement( second class classification and report); \( t_{\text{con}} \) – time of calculations for targeting; \( t_{\text{turn}} \) – time of maneuvering aircraft toward convergence course; \( t_{\text{con}} \) – time in the convergence course; \( t_{\text{turn}} \) – time of turning from convergence course to a fire point.

\( t_z \) All included times(except last two) are based on experience, but calculated with times \( t_{\text{con}} \) and \( t_{\text{turn}} \). The way spend for turning is equal to a half of the circle, then

\[
t_{\text{turn}} = \frac{\pi R_0}{V_0} \quad (3)
\]

Here \( R_0 \) – turn radius (virage), \( V_0 \) – turning speed(virage).

\[
D_z \geq D_{ZA} + (V_g + V_h) \cdot t_{\text{fight}} + t_{\text{block}}(V_g + V_h) \quad (4)
\]

Here: \( D_z \) – necessary distance, \( D_{ZA} \)– necessary detection distance.

Obtained formula will let us calculate the necessary detection distance for fighters. Based on the formula (4), we can find out the observation distance of radar stations on ship combinations.

Thus, during the organization of radio technical surveillance system on ships, the automation of management of battlefield surveillance systems in the Air Attack Protection Forces lets us detect an enemy, recognize him, determine the time spent for his classification and report and movement elements of targets, evaluate observational conditions and take correct decisions by the command, make calculations for targeting, reduce the timing of the transfer of the information about ship battles to radiotechnical surveillance units.

**Literature**


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