

About Solution of Problem of Construction Ship Radar of Higher Precision Class for Short-Range Navigation Purpose

A. N. Nechiporenko, L. D. Fesenko, and G. M. Krivosheeva

Kharkiv National University of Radioelectronics, Kharkiv, Ukraine

Received in final form April 25, 2007

Abstract—It is shown, that ship radars of *S* and *X* wave bands do not satisfy navigation safety conditions in close, coastal and internal waters, because of insufficient efficiency of precision parameters definition, and, consequently, because of small information capacity. Small value of probe pulse duration (about 70 ns) application allows to obtain high distance resolution, but it does not provide high azimuth resolution, because of some reasons. In this paper we consider one method of objects precision parameters improve by means of *Ka* or *W* wave bands radars application.

DOI: 10.3103/S0735272708070066

High accident rate at the ships of marine and river craft shows, that though existent radars and automated radiolocation construction systems for *S* and *X* wave bands have known advantages, they also have insufficient efficiency of precision parameters definition and little information. They also can hardly recognize a landmark, using radiolocation image, detect low-set and small objects and obtain an information about coming from the opposite direction ship class. It does not provide navigation safety in close waters, rivers, in narrow navigable paths and channels.

The purpose of this paper is analysis of radars application practice for short-range navigation and consideration of navigation radars precision parameters improving way.

Close waters are the most complicated navigation conditions, in these areas there are near 80% of all accidents. Navigation conditions in close waters are characterized by freedom of maneuver restriction, quick environment change, situation transience, frequent course change and lack of time. Thus, navigation specificity in internal waters and harborages is essentially differs from navigation in the open sea.

When ships come near in normal visibility conditions the main part of visual estimate is ship foreshortening. In summer time ship foreshortening is estimated practically immediately. But in the darkness, and especially in fog conditions a possibility of visual estimation is low. Using radiolocation image at the indicator from *S* and *X* range radar, the ship foreshortening is impossible to be estimated, hence it is impossible to estimate quickly whole environment. Insufficient radar control was registered at 72.6% cases of all ship collision in the fog. At the half of all cases echo-signals from the ships were detected, when distance between them was from 0.2 to 2 miles. In every third case a signal from the ship, came into collision, was not detected by radar at all. Duration of observation results processing to define oncoming ship movement parameters, environment estimation and maneuver choosing is 8–12 minutes at the average. In the condition of short objects detection distance (especially for high-speed ships) and lack of time it often leads to collisions [1].

Necessity of exact foreshortening position measurement of oncoming ships and good coast geometry observation requires applying at the ships of river and mixed (river-sea) type radar not worse than one at the large-capacity vessels of “Nayada,” “Ocean,” and “Orion” types. This requirement is also applied to small fishing vessels, yachts, harbor auxiliary ships (tugs, pilot boats, etc). Existing requirements of international conventions to big ships radar [Resolution A.477] are satisfied by antennas with dimensions about 3 meters, but it is inadmissible for small ships because of their low azimuth resolution. Small-size radars application does not satisfy requirements to close waters and harborage navigation. But at the same time it is possible to construct reflector, operating in *Ka* wave band with dimensions about 1 m, whose parameters are comparative with the best radars of *X* wave band ones.

It should be noted, that long detection distance is not the main factor of navigation safety, because environment conditions are characterized by richness of closely-located objects (coasts, floating navigation