Experimental radar with 64-channel digital antenna array

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Abstract – **In this article are analyzed a results of experimental radar with digital antenna array full-scale test against above-water targets.**

Keywords - **digital antenna array (DAA), analog-to-digital convertor (ADC**), **radar, transmitter.**

I. INTRODUCTION

The most urgent and determinative characteristic of new generation radar is the usage of DAA technology for antenna system fabrication. The current base capabilities allow of getting the most compact engineering solutions, for example the experimental radar with 64-channel DAA constructed by ARSENAL Corporation, Kyiv. Its construction is conditioned by the necessity of principal regulations practical check in the theory of multichannel signal analysis and effectiveness of existing DAA in the frequency range approximately 10 GHz. Successful full-scale test of this radar was conducted on the research laboratory of ships physical fields testing area of Mykolayiv shipbuilding center based in Sevastopol in October 2009.

II. MAIN TEXT

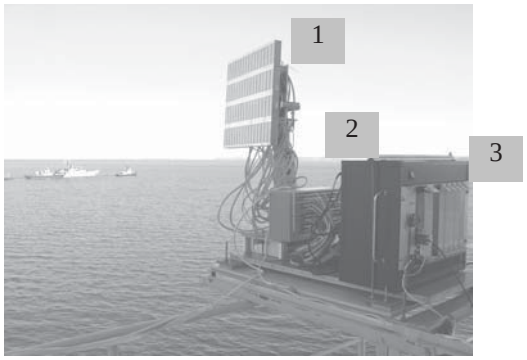
Radar consists of: reception system (pic.1); transmission system, constituents of horn antenna and solid-state amplifier; display device on computer basis. The reception system is the passive DAA formed by a range of subsystems including (pic.1):

- antenna array comprises 16 lines containing 4 vertical elements of print type each;
- 64-channel reception microwave module with 128 quadrature signal output of intermediate frequency;
- oscillator module and control signal forming;
- 128-channel intermediate-frequency amplifier module;
- block of 128 digital reception modules with calculator and synchronizer.

Transmitter radiation pulse power is approximately 40 Watt. Signal polarization is vertical. The duration and recurrence period of monitoring impulses adjust programmatically. The shortest radiative signal is 0,64 microsecond (μs), the longest - 5,12 μs. The maximum dimension of pulse packet accumulation is 256.

The transmission device was located at a distance from 1 to 6,5 m remote from antenna array during the tests. Since no evident influence of transmitting device influence on radar operational capacity was detected, while the creation of radar with DAA of different assignment joint as well as spaced structural arrangement of reception and transmission devices can be recommended.

On the first stage of tests most of attention is concerned to the technical state stability of reception paths investigation. **On the second stage** of tests most of attention was paid to radar operational capacity and operational quality check in the real radiolocation environment. Radiolocation targets were the above-water objects that were located in the radar operating zone during the tests.



Pic. 1. Radar reception segment («1» - 64-channel reception microwave module; «2» - 128-channel intermediate-frequency amplifier module; «3» - block of 128 digital reception modules with processor and synchronizer).

Radio engineering environment was getting more complicated by the reasons of twenty-four-hour operation in circular scan regime of "Nayada-5" radar from the pilot post in the distance of approximately 100 m.

The operation of radar under test was conducted in sectors: 18 degrees angle of elevation and ± 30 degrees by azimuth – in signal reception regime; ±15 degrees angle of elevation and ± 10 degrees by azimuth – in monitoring regime.

During the tests extended functional capabilities of radar with DAA were checked. Notably: steady operation with failure in one or more reception channels, including breakdowns of three from four horizontal lines of antenna array elements; local as well as detected and tracked objects binding to the field (map); determination and display of radar own coordinates; accountability of antenna slew while display of situation on the map; signal suppression of local objects; operation with different duration and monitoring pulse ratio; target tracking in quasi-continuous radiation mode; operational capacity of device in the environment of nonsynchronous impulse interference influence created by radar "Nayada-5"; radar operational capacity in the environment of intensive rain and wind (steady detection of above-water objects at the distance up to 8 km and tracking of targets kind of boat and launch (longboat)).

Conducted full-scale tests of experimental pattern 64-channel radar created by the technology of DAA proved the effectiveness of main construction principles, implemented technical solutions and developed software and algorithmic provision.

III. CONCLUSION

The experience obtained during development of experimental radar and results derived during tests enables successful creation of radar with DAA experimental pattern that would satisfy the demands of severe severity conditions in the abovementioned and bigger formats of antenna array.