Fiber-optic transmission system information for the testing of active phased antenna arrays in an anechoic chamber.

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Abstract. The results of the research of the developed fiber-optic transmission systems for analog high frequency signal are represented. On its basis, a new method to identify various structural defects in the active phased antenna arrays is elaborated.

1. Introduction.

Now there is a continuous improvement exploited and development of new fiber-optic systems transmission (FOST) of information, both trunk, and local assignment. But in recent years, analog FOST for transmission of a very high frequency of signals (radiophotonics) became an important component of development of local telecommunication area networks. Analog FOST were given the greatest application in radar-tracking systems of different function. Because in locations of radar-tracking systems the large number of various equipment and power stations are concentrated. In addition, the use of FOST data can reduce the weight and dimensions of the radar systems themselves, in cases of their use on aircraft, etc.

At the stage of designing and tuning the active phased arrays antenna (APAA) for radar stations arises many problems. One of them is the distortion of the signal in the transmission from the receiver to the high frequency analyzer at different APAA modes of operation during testing in an anechoic chamber (AC). These distortions are connected with the position of coaxial lines for transmitting signals to nearby high-voltage cables entering the APAA, and also location of the amplifier (without it the signal fades) in the area of direct radiation pattern of high power electromagnetic radiation (since the distance between the transmitter and receiver is smaller than 3 m). In addition, the placement of any signal transform microwave devices (e.g. network analyzer) in the AC violates its anechoic, which makes use of the camera is not expedient.

One solution of this difficult problem is the development of fiber-optic communication line, in which the analog signal from the receiving device placed in AC, transmits the received
electromagnetic radiation of APAA in the area of instrumentation location through the region with a complex electromagnetic environment.

2. **Fiber-optic transmission system and measurement technique**

Since the signals from the microwave generators are also transmitted to APAA via cables placed near the lines with high voltage for a variety of its devices (in AC there is only one entrance - it's also the output for all switching elements), so for this purpose it is also desirable to use FOST. This will improve noise immunity in addition to significantly reduce the size of the connections, and unload the platform on which is placed APAA. Additionally, higher accessibility to the equipment in case of repair will be provided and to testing of APAA and the load of the mechanical elements providing movement of a platform when scanning the APAA pattern will be.

In Figure 1 a block diagram of the test stand for testing APAA in AC is represented. For the implementation developed by us the fiber-optic communication line the high-frequency laser module 1 was selected (“Dilaz” company) – it is the transmitter with direct modulation with wavelength 1310 nm. The receiver is an optical module 2 (“Dilaz” company). Choosing a transmitter with direct modulation is caused by a small length of optical line (350 meters long) and more stability of its parameters to temperature changes. As the APAA testing with use of FOST developed by us must be held in case of ambient temperatures from 233 to 323 K (real operating conditions of radar station). A part of temperature conditions is provided when testing APAA in AC. Remaining temperature conditions are checked when testing APAA in the conditions of a polygon in the presence of opportunities.

![Diagram](image)

**Figure 1.** Block diagram of the test stand for testing APAA in AC.; 1 - laser module; 2 – receiving module.

The data obtained from measuring probe are coming over FOCL on vector network analyzer 4 with the subsequent processing on the personal computer 6.

3. **Results and their discussion.**

As an example, in figure 2 AFC in case of transmission of analog signals of a very high frequency on FOST developed by us for different temperature conditions of its operation are provided.
The analysis of the received experimental result shows that losses of power during transmission of a very high frequency of a signal on FOST developed by us in the frequency range of operation of APAA in the range of temperatures of its operation – aren’t essential. It allows using FOST developed by us for testing of APAA, as in the conditions of AC, and also at a polygon and the place of operation.

As the experiments showed the use of the developed FOST allowed, to research besides range of radiation of all APAA in different operation modes, also the ranges of radiation of its single active elements. These researches weren’t possible earlier because of the existence of different noises, in particular the noise in the transferring path.

As an example, Figure 3 shows the emission spectra of a single active element APAA, transmitted to the control sector from the registration device of high frequency signal over coaxial cable, and developed by authors FOST.
Figure 3. (a, b, c, d). (a, c) The emission spectra of a single active element on 10.5 and 8.5 GHz frequency transmitted through a coaxial cable; (b, d) – FOCL.

Analysis of the results, shows that the use of the developed by us FOST allowed to completely eliminate transmission by it unpredictable RF disturbances and different induced signals, taking account of which and their further compensation (for example, subtraction) requires numerous additional measurements. Now changes in the registered pattern of the APAA single elements are connected only with the change of parameter of the very high frequency signal radiated by the antenna or defects of montage, and in the emitter itself. At the presence of the defect of the installation constriction or in the emitter itself, the change of the pattern form takes place (for example reduction of amplitude of a maximum, etc.). Comparing of the constructed patterns of different emitters allows determining these defects.

4. Conclusions
The carried out researches showed that the use of FOST developed by us allows to solve the problems considered earlier arising during testing APAA in AC with use the coaxial cable for transmission of a very high frequency signal. Besides that, the use of FOST allowed to develop a new technique of determination, both defects of assembling of APAA, and defects in the construction of an individual emitter. We can test each emitter of APAA as a part of all operating construction of the APAA. The received results of researches confirmed feasibility of the FOST use for testing APAA and validity of a new developed technique of its different defects determination.

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