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A SUPER-WIDEBAND ANTENNA ARRAY FOR RADIO DIRECTION FINDING AND RADIOLOCATION COMPLEXES

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The suggested design of a small-size antenna array composed of elements in the shape of Vivaldi's antennas has been tested in the 1–2 GHz range of frequencies.

In radio direction finding and radar applications, in order to measure with high accuracy the angle coordinates of radiation sources and of object's, various types of antenna arrays composed of directed elements are used [1]. When selecting the shape of the elements of such array, operating in an ultra-wideband range of wavelengths from λ_{min} to λ_{max}, fulfillment of the following requirements is desirable: in the long-wave part of the operation range the mutual impact of the elements must be minimum while in the short-wave part — to ensure single-valuedness in estimating the angle coordinates, the distance between neighboring elements must not exceed 0.7–0.8λ_{min}; the lateral dimensions of the elements must also be minimal, and it is desirable that the field transformation occurs not in some particular parts of the element (such as the end part of the waveguide) but, if possible, on the whole surface of the element, thus improving the mass-and-dimension indices of the array.

The waveguide elements hardly could meet these requirements: they have considerable dimensions in the *H*-plane; their band of operation frequencies is limited because of emergence of higher modes; and the currents may easily overflow to waveguide's outer side resulting to their mutual negative impact.

Logoperiodic dipole antennas meet nearly all requirements mentioned above. Unfortunately, a pair of such antennas, with their parallel planes closely spaced, forms a sort of evanescent waveguide between them, which diminishes the working wavelength λ_{max} substantially. In addition, dipole antenna arrays are characterized by high mutual impact, which in the end has a negative effect on precision of the direction-finding equipment.

In this work, for the basic receiving elements of the array we took the Vivaldi antenna [2] falling in the class of travellig-wave aerials, in which the whole length is used for wave reception. The electric component of the field in the Vivaldi antenna is mainly concentrated inside the slots, so that the rate of mutual influence of the elements in the array is minimal even at very low frequencies. Moreover, the antenna has rather small lateral dimensions, dictated by thickness of the dielectric substrate, and can be fabricated with the use of printed circuit board technology.

The topology of a single element of the array designed for operation in a super-wideband frequency band of 1–2 GHz (the "wide-bandness" index [3] $\mu = 1/3$) is shown in Fig. 1. The material of the substrate is polystyrene 3 mm thick.

For excitation of the array elements we suggest a symmetric and matching strip transformer connected to the Vivaldi antenna in the narrowest point of the slot as shown in Fig. 2. In the figure: *1* is a transformer (50 Ω at the asymmetric input and 115 Ω at the symmetric input); *2* — two polystyrene sheets (317×250 mm^2) with metal strips between them; *3* — the maximum sensitivity direction; and *4* — the metal strips. Good matching in the wide band of frequencies is attained due to similarity of structure of the hybrid waves in the antenna and transformer.

REFERENCES

1. L. D. Bakhrakh and D. I. Voskresenskii (editors), Problems of Antenna Equipment [in Russian], Radio i Svyaz', Moscow, 1989.

2. K. S. Yangvesson, D. H. Schaubert, T. L. Korzeniowski, G. L. Kollberg, T. Thungren, and J. F. Johnsson, IEEE Trans. Antennas and Propag., Vol. 33, No. 12, pp. 1392–1400, 1985.

3. H. F. Harmuth, Non-Sinusoidal Waves in Radiolocation and Radio Communications [Russian translation], Radio i Svyaz', Moscow, 1985.

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