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A DIGITAL MICROWAVE AMPLI-PHASE METER FOR RADIO-ENGINEERING SYSTEMS OF SPECIAL PURPOSE

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The paper describes a digital microwave amplitude-phase meter with a unified algorithm of functioning for special-purpose radio-engineering systems.

The issue of unification of signal digital processing in antenna devices of radio-engineering systems (RES) is a pressing problem. However, another problem is that in some cases we have to process simultaneously the signals in different types of antennas, different RES, and at different levels of reception noise.

The paper is devoted to description of a digital microwave amplitude-phase meter (DMWA) able to perform digital amplitude-phase processing of signals in the antenna microwave channel with the aid of a unified algorithm. In the paper we consider three variants of antenna devices represented in the DMWA form. The first variant is the linear equidistant antenna array (LEAA) (Fig. 1). The second variant is the planar equidistant antenna array (PEAA) (Fig. 2). The third variant represents a PEAA located in the focal plane of two parabolic antennas (PA) connected as a two-element radio-interferometer (Fig. 3).

These antenna devices are represented in the form of DMWA for measuring the signal amplitude and phase with the aid of LEAA and PEAA equipped with a digital antenna-reception system and a microprocessor (Figs. 1 and 2), and in the form of two PA with a LEAA playing the role of radio-interferometer with a digital antenna-reception system and a microprocessor (Fig. 3). Mathematical description of the amplitude and phase relations between signals at DMWA output is performed with the aid of a unified algorithm making it possible to unify the following procedures: (a) shaping the maximum of the radiation pattern (RP) of DMWA in the direction of RP angular coordinates (θ,φ) when the RES is working in transmission conditions; (b) determination of signal-to-noise ratio S/N (θ,φ) when the RES is working in reception mode; (c) determination of the signal amplitude $U_{ij}(\theta,\varphi)$ and its phase $\Phi_{ij}(\theta,\varphi)$ in DMWA simultaneously at a very high frequency and at a low frequency; and (d) description of operation of different types of antennas in the RES circuit.

The term "unified algorithm" means that it includes three parts responsible for different variants of antenna devices. This structure makes it possible to use this algorithm simultaneously for describing variations of the signal amplitude and phase when the RES works with the three variants of antennas.

The first part of the algorithm describes operation of DMWA, whose main part is LEAA having the amplitude and phase RP with controlled amplitude-phase distribution over LEAA opening. This part of the algorithm identifies the LEAA and DMWA parameters when measuring the amplitude $U_{ij}(\theta,\varphi)$ and phase $\Phi_{ij}(\theta,\varphi)$ of a signal with preset directions of angular coordinates by the criterion of maximum signal-to-noise ratio.

The second part of the algorithm describes operation of DMWA, whose main part is PEAA and, in conformity with the amplitude and phase RP of the PEAA, determines the amplitude-phase distribution over PEAA aperture, and checks the amplitude $U_{ij}(\theta,\varphi)$ and phase $\Phi_{ij}(\theta,\varphi)$ of the signal in DMWA channels. This part of the algorithm identifies the PEAA

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