Radioelectronics and Communications Systems
Vol. 47, No. 1, pp. 28–35, 2004

Izvestiya VUZ. Radioelektronika
Vol. 47, No. 1, pp. 38–49, 2004
UDC 621.386.67.061

THE STRUCTURE OF SOLUTIONS TO THE PROBLEM OF SYNTHESIS OF A LINEAR MICROSTRIP ANTENNA ARRAY WITH THE USE OF ENERGY CRITERION

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The paper considers the structure of solutions to the problem of synthesis of a linear microstrip antenna array corresponding to a prescribed radiation pattern in terms of power. It is shown, based on the methods of nonlinear analysis, that typical features of this class of problems are nonuniqueness and bifurcation of solutions. The number and qualitative characteristics of the solutions depending on the regularization parameter are investigated.

Nonlinear problems of radiation system synthesis are known to have, as a rule, several solutions [1, 2], which complicates the numerical treatment of the problem. At the present time the general methods of investigation of this type of problems are absent. As shown in [2–4], the problems of antenna synthesis by a prescribed amplitude radiation pattern (RP) often lead to ramification of solutions depending on the parameter values of the radiation system and on the properties of the given amplitude RP. In this work we investigate the number and the qualitative characteristics of solutions to the problem of synthesis of a linear microstrip antenna array by a given energy RP, when for the optimality criterion the smoothing functionals are taken. In a particular case, we use the nonlinear analysis methods to show that this class of problems exhibits bifurcation of solutions depending on the regularization parameter value. The investigations given below represent a further extension of the approach described in [5].

The problem of analysis of a finite microstrip antenna array (AA) is based on a method permitting to consider the interrelation between the array elements in terms of a given distribution of the surface current density on the radiators [6, 7]. Under this assumption, the interaction of the radiators changes only the current amplitude, which facilitates considerably the calculation of antenna array characteristics.

Basic equations of the synthesis. Consider a linear equidistant AA consisting of $N = 2M + 1$ identical, having the same orientation, rectangular, ideally conducting and infinitely thin radiators of a length l and width w. The Cartesian coordinate system and the spherical one related to it are introduced so that the origin coincides with the plane of an ideally conducting screen, and the OZ-axis is perpendicular to the screen. Assume that the radiators are arranged equidistantly along the OY-axis so that the central radiator has coordinates $(0, 0, h)$. Introduce the generalized angular coordinates

$$\xi_1 = \sin\theta\cos\varphi, \quad \xi_2 = \sin\theta\sin\varphi.$$

The above assumptions imply that the array RP is described by the formula [4]

$$\vec{f}(\xi_1, \xi_2) = \left\lfloor \psi^{\perp}(\xi_1, \xi_2)\vec{e}^{\perp} + \psi^{\parallel}(\xi_1, \xi_2)\vec{e}^{\parallel} \right\rfloor f_{\Sigma}(\xi_2)$$

where $\psi^{\perp}(\xi_1, \xi_2)$ and $\psi^{\parallel}(\xi_1, \xi_2)$ are the components of a RP radiator; and $\vec{e}^{\perp}$ and $\vec{e}^{\parallel}$ are unit vectors of the projection of the wave vector on the XOY-plane, and

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6 December 2001