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A METHOD FOR CALCULATION OF LINEAR ANTENNAS WITH IMPEDANCE ELEMENTS

N. N. Gorobets and V. V. Ovsyanikov

Kharkov National University, Ukraine

Dnepropetrovsk National University, Ukraine

A method is developed for design of small-size antenna systems with an extended range of frequencies. The antennas are composed of linear conductors with lumped reactive elements. The method includes such operations as synthesis of the antenna system, analysis of its characteristics, and parametric optimization of values of the lumped reactive elements and coordinates of their connection to radiating branches of the antennas.

There are many methods for improvement of characteristics of various types of antennas — dipole, stub-dipole, frame, turnstile, log-periodic etc.; and of antenna arrays composed of linear wires, when reactive or impedance elements are connected in series with their radiating branches. The potentialities of these methods have not been adequately studied, and some issues concerning the design of such antennas remain unsolved. They include: the type of impedance element (IE) connected to the antenna — capacitive, inductive, complex, or purely active; dependence of parameters of the introduced IE on initial dimensions, configuration, and type of the antenna; optimal value of IE and coordinates of its connection; the impact of the IE magnitude and connection coordinate on the efficiency factor, input impedance, bandwidth, and other characteristics of the antenna.

In the known literature on such antennas one can hardly find a comprehensive answer to these questions, and any general approach to design of linear antennas with IE is absent [1, 2]. Thus, a pressing and practically important problem is the development of appropriate mathematical models, effective algorithms and programs for calculation of antennas with IE.

In this work we describe the results of development of a general method for designing of antenna systems (AS) with impedance elements.

The stages of calculation of antenna systems with reactive or impedance elements. The research and development of AS is performed in three stages: development of a mathematical model of the antenna system for its subsequent synthesis; analysis of characteristics of the AS conceived; and parametric optimization of IE and coordinates of their connection to the AS radiating branches.

Prior to design of AS with IE, let us formulate some technical requirements to its parameters, particularly, for directivity factor, current flow distribution over AS, input impedance, radiation resistance, efficiency, etc. In addition, we set some external characteristics: the driving voltage, wave resistance of the feeder at the AS input, and the environment parameters.

At the first stage we develop the mathematical model for AS synthesis based on the method of equivalent long line (ELL), and use this model for calculating the impedances and coordinates of their connection. At the second stage we generate the AS mathematical model for numerical analysis of AS characteristics in the strict formulation with the use of

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