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ALGORITHMIZATION OF PROBLEMS OF EXCITATION OF WIRE STRUCTURES WITH ROTATIONAL SYMMETRY

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A universal algorithm is suggested for analysis of excitation of arbitrary thin-wire structures with rotational symmetry.

In [1] a new universal algorithm was described used for analysis of excitation of an arbitrary wire structure consisting of a set of thin rectilinear wires of cylindrical cross-section. As always, when dealing with the method of integral equations, the computational expenditures include calculation of respective matrix elements followed by treatment of the system of linear algebraic equations, so that the computational cost is proportional to the number of unknown variables raised to the third power. Hence in the general case, even with the use of modern computer facilities, we hardly can advance to the high-frequency domain substantially. The account of body's symmetry facilitates the calculation. The rotational symmetry is especially useful, since it permits to set up equations corresponding to a single cell. The situation resembles that taking place in investigation of continuous polyhedral bodies with rotational symmetry, when we can reduce the integral equation over the whole surface of the body to the equation over the surface of a single facet and thus lower the problem dimensionality [2].

The purpose of this work is further development of the universal algorithm [1] as applied to thin-wire structures with rotational symmetry, which makes possible to reduce the problem dimensionality almost to a single cell. We consider wire structures with M-pole symmetry: when rotating through an angle $\psi = 2\pi/M$, where M is an integer, the structure turns into itself. With symmetry of this kind, the geometry of the wire structure is fully defined by geometry of a single cell, and is described exactly in the form given in [1].

Figure 1 gives an example of such a structure with 4-pole symmetry. One of possible variants of selection of a unit cell is shown by the dotted line.

When setting up the algorithm for a single cell, the main problem is to take the galvanic contact between the adjacent cells into account (in the absence of such contact the cells are isolated from one another, and the problem becomes almost trivial).

The presence of the galvanic contact between cells leads to emergence of current flow through the respective nodes. To take this current into consideration, we have to introduce the appropriate basic harmonics. The main property of these harmonics is as follows: their arms must be located in different cells. Since the algorithm for creating the current harmonics is strictly linked to branches, the unit cell has to be supplemented with virtual branches belonging to the neighboring cells.

First of all, formulate the mechanism of establishing the contacts between the cells. To do this, introduce the concept of "dual" nodes. Two nodes, belonging to a single cell, are called dual if (a) in the case of rotating through an angle ψ one node passes into the other, and (b) the contact between adjacent cells is created by these nodes. Particularly, for the structure shown in Fig. 2, the pairs of nodes *1* and *2*, and also *3* and *4* are dual.

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