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Modeling Of Electromagnetic Fields Of Microwave Devices On The Basis Of Matlab Program

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***Abstract*- According to calculation with use of «MATLAB» program types of electromagnetic waves (TE, TM) which are spreaded in considered over microwave line of transmission. According to calculation types of electromagnetic waves (TE, TM) which extend in considered over a high-frequency (microwave oven) transmission line rather precisely decide on use of the MATLAB program. Knowing exact distribution of wave spendthrifts in the subsequent it is represented possible calculation of technical parameters in particular, good qualities, tensions of fields etc. by relations known from literature.**

***Key words*-algorithmization, mathematical modeling, microwave transmission lines, the waveguide modes, matrix of communication and transmission.**

I.INTRODUCTION

One of important types of devices of modern technical means of radio engineering and communication are the microwave transmission lines, possessing such known advantages as high reliability, profitability etc. Advantages and features of the microwave transmission lines at their use in radio engineering allow solving the most various problems what is not always possible to implement on the basis of other element base [1-3]. Complexity of modeling of similar microwave transmission lines increases more when for receiving practically satisfactory results the combination of several calculation methods often is obviously necessary that in its turn connected with considerable expenses of labor and time. Thus rather complex challenge is also possibility of effective application of modern types of computers at calculations by these methods. The microwave ovens of a transmission line possessing high reliability, stability of parameters and durability in use have an extensive scope in technology of communication, nuclear physics, medicine, antenna equipment, television, and also in other areas of science and equipment. Despite a wide scope of the microwave transmission lines, still there are no methods applied for practical purposes which sufficiently would reflect the electromagnetic processes happening in the microwave transmission lines. In rather known methods difficult classical mathematical apparatuses are often used which considerably complicate carrying out engineering calculations. At the present time effective use of various microwave lines in radio engineering and means of communication demands application of the new calculation methods of modeling based on improvement of the computing device by algorithmization and creation of the mathematical models which are most reflecting variety of the specific properties considered by the microwave transmission lines that in turn is an actual task. These purposes are quite answered by modern numerical methods of modeling which give the chance to formalize completely and algorithmization the made calculation, reducing the quantity of the symbols used at intermediate operations by drawing up calculated formulas and differ in the strict sequence of the elementary operations. Development and deployment of these methods is connected with wider use of modern computers. At the same time effective use of computers demands the use of more economic computing algorithms and programs. Increasing of quality of microwave transmission lines is actual problem of instrument making and application of modern numerical methods of modeling at their designing would give the chance to achieve a goal with minimal expenses of labor. It should be mentioned that one of the most important problems of a tendency of development of microwave technique is exact determination of parameters of electromagnetic field extending on transmission lines of microwave range. Parameters of microwave transmission lines are defined by the structure of electromagnetic field that demands from a design of performance of the conditions providing stable excitement of the necessary structure of a field. Exact determination of parameters of microwave transmission lines of microwave range considerably improves their quality factor that allows defining optimum overall dimensions and weight, to increase reliability, to reduce economic expenses, to improve a number of electric and technical characteristics of these devices. At the same time the problem of increase of reliability of these designs which is reached due to rather exact determination of parameters of an electromagnetic field that allows solving the return problem, i.e. to improve the quality factor of these devices is not less important. At improvement of quality factor of the microwave designs their technical characteristics also improve as intensities of electric and magnetic fields of the microwave waveguides are directly proportional to quality factors of these devices. Besides, the question of definition of types of the extended waves in the microwave devices is rather serious. Taking into account the above mentioned it is necessary to define

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from broad variety of numerical methods the most expedient numerical method for the solution of goals.

II.MICROWAVE TRANSMISSION LINES WITH SPLITTING INTO ELEMENTS

For this purpose let's consider possibility of use for our purposes a numerical method of the final [4-8] elements which found broad application in various spheres of technical devices. Let's determine distribution of waves of TE and TM models to the microwave transmission line by method of final elements on the basis of use of the MATLAB program. On picture 1 are shown 18 elements, 16 points.

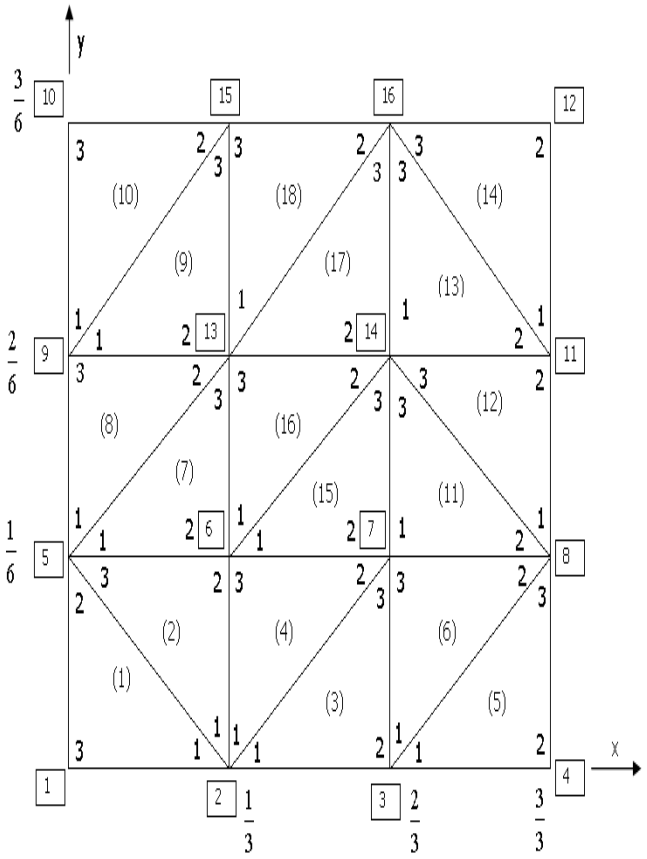

Fig.1. Microwave transmission lines with splitting into elements.

III. THE RESULTS

Table 1 reflects coordination of registration of wave modes, and in table 2 the communication matrix is given.

Table 1. Coordination table of wave modes registration

Main points	X	Y
1	0	0
2	1/3	0
3	2/3	0
4	3/3	0
5	0	1/6
6	1/3	1/6
7	2/3	1/6
8	3/3	2/6
9	0	3/6
10	0	2/6
11	3/3	3/6
12	3/3	2/6
13	1/3	2/6
14	2/3	3/6
15	1/3	3/6
16	2/3	3/6

Table 2. Table of connection of waveguide modes registration

	Elements								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
n 1L	2	2	2	2	3	3	5	5	9
n 2L	5	6	3	7	4	8	6	13	13
n 3L	1	5	7	6	8	7	13	9	15
	Elements								
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
n 1L	9	7	8	14	11	6	6	13	13
n 2L	5	8	11	11	12	7	14	14	16
n 3L	10	14	14	16	16	14	13	16	15

For TM type of waves we have

$$prn = [1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 15, 16]$$

$$frn = [6, 7, 13, 14]$$

To TE type of waves all values correspond. Using program of calculation "MATLAB" we determine wave numbers $K_c = \sqrt{\left(\frac{m\pi}{a}\right)^2 + \left(\frac{n\pi}{b}\right)^2}$ with calculation of matrix of S connection and matrix of T transmission.

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$$ATE = inv(T)^{*} S_i$$
$$[EVTE, K_c \cdot sqTE] = eiq(ATE)$$
$$KCTE = sqrt[diaq(kcsqTE)]$$
$$K_c TES = sort(K_c TE)$$

According to calculation program we define:
where

$$(K_c)_{TE} = 3,2795,$$
$$(K_c)_{TE_{10}} = \pi = 3,14,$$
$$(K_c)_{TM_{11}} = \pi\sqrt{5} = 7,0248.$$

IV.CONCLUSIONS

According to calculation with use of «MATLAB» program types of electromagnetic waves (TE, TM) which are spreaded in considered over microwave line of transmission. According to calculation types of electromagnetic waves (TE, TM) which extend in considered over a high-frequency (microwave oven) transmission line rather precisely decide on use of the MATLAB program.
Knowing exact distribution of wave spendthrifts in the subsequent it is represented possible calculation of technical parameters in particular, good qualities, tensions of fields etc. by relations known from literature [1, 3].

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