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ANALYSIS OF NUMERICAL MODELING PROGRAMS OF THE MICROWAVE DEVICES OF TELECOMMUNICATION SYSTEMS

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Technical progress and development of a radio engineering devices now is inconceivable without wide application microwave devices of superhigh-frequency of a range. It is connected by that last years the frequency spectrum of the microwave of a range is widely applied in intensively developing branches of telecommunication, radio engineering, and also in radiorelay, satellite and ground communication systems.

It is known [1-3], that in a range of the microwave strict enough description of the physical phenomena is spent on the basis of the theory of an electromagnetic field. And theoretical definition of electromagnetic fields the microwave devices is reduced to the decision of equations Maxwell or the following from them the wave equations at the set coordinates, parameters of borders of considered area and parameters of environment filling area. And it compels to resort to labour-consuming mathematical models of the theory of a field that is connected with significant complication of the description of the phenomena of the microwave of a range. Therefore in practice for modeling an electromagnetic field on the basis of the automated designing various microwaves devices often use modern high-speed computer programs. At practical use of the automated designing the microwave devices it is necessary to apply the big file of the programs developed to the present time.

In the given work the analysis of the modern high-speed programs most popular to the present time for modeling the microwave devices on the basis of the decision of the equations of electrodynamics [4,5]. Such programs are:

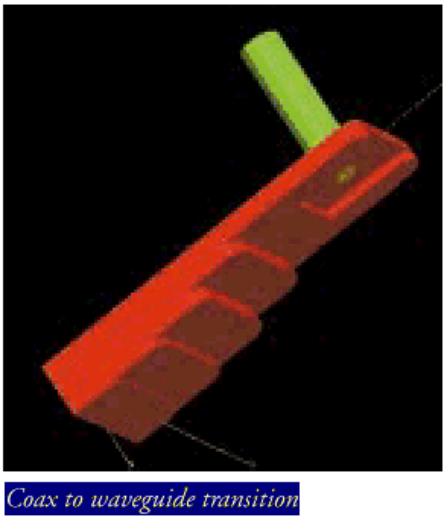
1. "HFSS" (High Frequency Structure Simulator) – the American company "Hewlett-Packard";
2. "Microwave Office 2002" – the American company "Applied Wave Research";
3. "Mafia 4" - The German company CST (Computer Simulation Technology);
4. "CST Microwave Studio" – the same company;

It is necessary to note, that except for these programs there is enough plenty of other programs for the automated designing the microwave of the devices made in Russia and other countries of the Europe.

The program of three-dimensional electromagnetic modeling for the automated designing the microwave devices HFSS (High Frequency Structure Simulator) is a powerful software package which calculates S-parameters and electromagnetic fields for three-dimensional passive structure of the any form [4]. It has the intuitive interface simplifying the description of the project, the powerful program of calculation of an electromagnetic field, adaptive to demanded accuracy of the decision, and the powerful postprocessor for unprecedented representation of electromagnetic characteristics. This program eliminates traditional prototyping by a method "Cut-and-try" (tests and mistakes), accelerating and improving quality of designing. HFSS realizes power of a method of finite elements (finite element method FEM), using methods of type of automatic adaptive generating and division of cells, a method of finite elements for vectors of a field and adaptive development (Adaptive Lanczos Pade Sweep, ALPS). HFSS automatically calculates multiple adaptive decisions up to criterion of convergence defined by the user. Decisions for a field, found of Maxwell's equations, precisely predict all the dispersive characteristics, existing types of waves, transformations of types of waves, losses in materials and on radiations.

The analysis of the microwave of lines of transfer, elements, filters of the microwave and three-dimensional is reduced to plotting structure, exact definition of a material, identification of ports and characteristics of surfaces. HFSS automatically generates decisions of a field, port

characteristics and S-parameters. Below, on pic.1. the three-dimensional image koaksial-wave transition of the microwave of the device after modelling on HFSS is shown.



Pic.1. Three-dimensional modelling koaksial-wave transition of the microwave of the device

Results of calculations of modelling can be exported for further use in programs of the analysis of linear and nonlinear schemes, in particular, in program Serenade Ansoft.

The program " Microwave Office 2002 " is most convenient at designing planar microwave of devices [5]. Volumetric elements in it are represented as a level-by-level set of planar elements. This program, unlike the previous versions, is based on operational system Windows that facilitates work with it. The program allows to spend the analysis both linear, and nonlinear schemes to synthesize the microwave of the device directly under its basic scheme. Microwave Office includes two modules:

Voltaire XL - a package of modeling of linear and nonlinear schemes.

EMSight - system of three-dimensional electromagnetic modeling.

Voltaire XL - a package of modeling of linear and nonlinear schemes.

Voltaire XL is a package of modeling of linear and nonlinear schemes and uses following methods:

-numbers Volter (static and parametrical);

-high-speed method of the linear analysis;

-the high-speed method shumovogo the analysis,

-the integrated system of input of schemes with the built in support of files of the description of systems Spice and MMICAD.

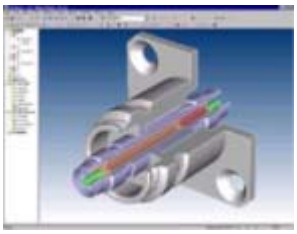
Microwave Office is written in object-oriented language C++, it can easily include new methods of modeling in process of occurrence. This program works under control of 32-bit OS, such as Windows XP. Microwave Office includes EMSight v.2.0 and essentially new package of linear and nonlinear analysis VoltaireXL.

Module EMSight v.2.0 - the Package of full electromagnetic modeling of the microwave of systems. It represents the graphic environment for the fast analysis of electromagnetic behavior of various structures which often meet in high-frequency integrated schemes (RFIC), monolithic microwave microcircuits (MMIC), microstrip aerials and high-speed digital printed-circuit-boards. System EMSight at calculations uses a method of moments Galerkin which, represents the most exact and steady algorithm of the electromagnetic analysis.

The program " Mafia 4 " allows to model precisely as planar, and microwave frequency-selective structures, various types of the microwave of devices. Program MAFIA (from English MAxwell's equations by the Finite Iteration Algorithm), foundation on a time method of the

certain integrals (Finite Integration method). The basic concept of this method is developed by Prof. Thomas Weiland in 1975 then the method has won a recognition of professionals and has received wide application. Last version of program MAFIA delivered now 4 allows to model practically any systems where there are the effects connected with radiation, distribution and absorption of electromagnetic fields.

The program " CST Microwave Studio " is the fast and exact program of modeling of flat and volumetric microwaves of devices with the purpose of reception of their S-parameters. It has the graphic editor for a portrayal of a kind of three-dimensional structures, and also for construction of frequency dependences of parameters. For example, on pic.2. the three-dimensional image of the microwave transition created under the program " CST Microwave Studio " is shown.



Pic.2. The three-dimensional image of the microwave transition

In a basis of the program the method of approximation developed by company CST for ideal boundary conditions (PBA), successfully supplementing well proved method of the certain integrals (FI), working in time area lays. In any method connected with modeling of finite elements, all surfaces are broken into small elements. If the model of the microwave of the device is set only by direct planes the number of analyzed elements of splitting is insignificant, and calculation is spent rather quickly. At use in the microwave devices of curvilinear surfaces, for their approximation a lot of elements of splitting that leads to significant time expenses at the analysis is required much more. The combination of methods PBA and FI, offered by company CST, has allowed to solve quickly problems of modeling of complex microwave of devices with curvilinear surfaces on widely widespread computers with processors Pentium. The typical devices modeled by means of package CST Microwave Studio:

- the microwave and microstrip directed devices ;
- one and multilayered microstrip structures;
- various microwave of a line of transfer;
- koaksial-wave and wave-strip transitions;
- optical wave guides and switchboards.

In summary it is necessary to emphasize, that the modern computer technics and its software develop and improved with the big speed, duly use of computer methods therefore is necessary at modeling electromagnetic fields of the microwave of devices with the purpose synthesis optimum elements and designs of telecommunication networks.

References

1. V.V.Nikolsky "Electrodynamics and distribution of radiowaves", Moscow, the Science, 1973, 607 p.
2. E.Q.Ismibeyli, Y.Q.Qaziyev The International conference "Physics-2005", Academy of sciences Azerbaijan Republic, Baku, 2005.
3. E.Q.Ismibeyli, I.G. Islamov, Y.Q.Qaziyev The International conference "Modern information and electronic technologies", Odessa, 2003, p. 57.
4. Bankov S.E., Kurushin A.A., Razevig V.D. "The analys and optimization of three-dimensional MICROWAVES of structures by means of HFSS " Moscow, 2004, 208 p.
5. Razevig V.D., Kurushin A.A., Potapov J.V. " Designing of the microwave of devices by means of Microwave Office " Moscow, 2003, 496 p.