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MESH GENERATION ALGORITHM FOR CALCULATING THE ELECTROSTATIC FIELD BY THE METHOD OF MOMENTS

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This paper describes the process of developing the mesh generation algorithm for calculating the electrostatic field of a transmission line by the method of moments. The developed algorithm is implemented and tested in the TALGAT software.

Keywords: electrostatic field, transmission line, method of moments, mesh generation, electromagnetic compatibility, TALGAT software.

Ensuring electromagnetic compatibility (EMC) is an important task in the development of radioelectronic equipment (RE). Therefore, it is recommended to use mathematical modeling, which can reduce the financial costs and time spent on the RE development, in comparison with physical modeling. At the same time, one of the universal numerical methods used in the simulation of EMC problems is the method of moments (MoM).

One of the important tasks in the simulation of EMC problems is to estimate the distribution of the electrostatic field excited by the RE components, such as transmission lines. At the same time, the complexity of the physical connections of the simulated structures is often very high, so designers have to use specialized software that allows them to calculate and visualize the field distribution in the studied structures.

The domestic EMC simulation software TALGAT allows the designers to solve a wide range of quasi-static and electrodynamic problems using the MoM [1]. Nevertheless, it lacks tools for calculating and plotting the electrostatic field. In this case, the efficiency of the mesh generation algorithm is very important, since the mesh should be sufficiently frequent to maintain the accuracy of the calculations. Thus, the purpose of this work is to develop a mesh generation algorithm for calculating the electrostatic field of a transmission line by the MoM, and to implement it in the TALGAT system.

Algorithm development. In general, the algorithm for calculating the electrostatic field of a transmission line consists of the following steps: design of the cross-section, boundary segmentation, calculation of the charge distribution using the MoM, mesh generation, and calculation of the field value at the center of each mesh subdomain. Fig. 1 shows a block diagram of the mesh generation algorithm for calculating the electrostatic field.

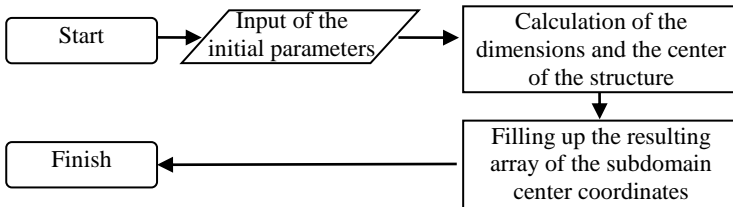


Fig. 1. Block diagram of the mesh generation algorithm for calculating the electrostatic field of a transmission line by the MoM

At the first stage of the algorithm, the user calls the CALCULATE_Xmesh (or CALCULATE_Ymesh) command implemented in the TALGAT system and passes the configuration of the analyzed transmission line, the coordinates of the starting and ending points of the mesh boundaries, as well as the minimum possible step value to the computing core as arguments. Then, the geometric center of the structure, its width and height are calculated. After that, the system iteratively fills in the output array with the coordinates of the centers of the subdomains relative to the selected axis. At the beginning of the array filling process, the step value is three times the initial value, but when the current point approaches the structure boundaries, the step begins to decrease, until it reaches the center of the structure (or the minimum step value). After reaching the center of the structure, the step begins to increase symmetrically until the value of the initial step is reached. This feature is due to the fact that during the field analysis, the area of interest is in close proximity to the voltage source. At the last stage, the function returns the calculated array to the main part of the script and finishes its work.

In the course of the algorithm implementation, the C++ language was used, since the core of the TALGAT system is made using this language. The matplotlib library and the Python language were used to test the performance of the mesh generation algorithm, respectively [2]. This library was chosen because of its simplicity, accessibility, and detailed documentation. In addition, the TALGAT system includes a Python interpreter.

To verify the results of the electrostatic field calculations, a test run of the algorithm was performed in the TALGAT system and in the FEMM software [3]. A rectangular air-filled coaxial line was used as the analyzed structure ($\epsilon_r = 1$). The ratio between the sides of the inner and outer conductors was 1/3. Fig. 2, *a* shows a graphical representation of the electric field calculated for the mesh obtained using the developed algorithm, while Fig. 2, *b* shows the results obtained using FEMM. The comparison shows that although the field patterns are slightly different, the results are consistent.

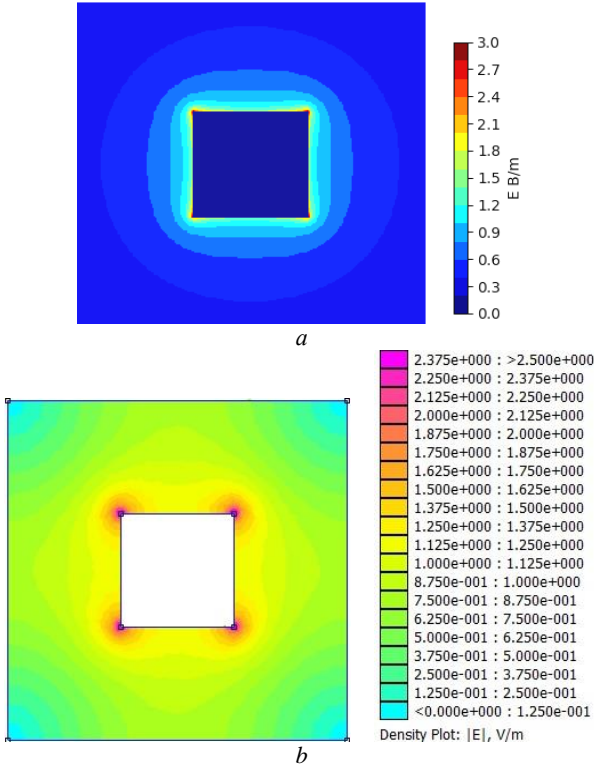


Fig. 2. The electrostatic field obtained using the developed algorithm (a) and the FEMM software (b)

Conclusion Thus, the mesh generation algorithm for calculating the electrostatic field by the MoM was developed and implemented in the TALGAT system. It is shown that the use of this algorithm reduces the time spent on the calculation of the electrostatic field of a transmission line, and at the same time maintains the accuracy of the calculations.

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SEGMENTATION OF BRONCHOPULMONARY ASPERGILLOSIS IN CT IMAGES USING A PATCH-BASED ATTENTION NEURAL NETWORK

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In this paper, we present a patch prediction neural network developed to identify invasive pulmonary aspergillosis. The system identifies the patches through maximum intensity projection. Patch frames are defined to detect similarities in all input slides, and a decision is made to check if the selected patch is an aspergillosis patch before it is segmented. The output of the system is characterized by high accuracy and less computational cost.

Keywords: Aspergillosis, Segmentation, Patch-Based CNN, Lung CT images, Convolutional Neural Networks, Maximum Intensity Projection.

Introduction. Aspergillosis [1] is a mycotic fungal lung disease. If it is not identified in the early stage, it leads to the development of asthma, cystic fibrosis, tuberculosis, sarcoidosis, and more illness in the patient. The type of illness developed from aspergillosis [1] varies according to the health of the lungs, severity of attack and the signs of infection. Till date, no automated technology has progressed further regarding the identification of this disease. If the radiologist is aided with automated detection, the recovery process can be speeded up [2, 3]. Since the disease forms patches within the lungs, this study is aimed to investigate segmentation of these