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ДИЈАКОПТИЧКА АНАЛИЗА ЕЛЕКТРОМАГНЕТСКИХ СИСТЕМА

Diakoptic Analysis of Electromagnetic Systems

– Докторска теза –

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Abstract. The main scientific contribution of this thesis is the introduction of a new method for numerical analysis of electromagnetic systems. The method represents one possible approach to overcome the problem of limited computer resources that arises in cases of analysis of large and complex electromagnetic systems. The proposed method is referred to as the diakoptic analysis, due to the fact that it is based on the same basic ideas of splitting the original problem on several smaller and computationally simpler subproblems, as the diakoptic analysis of circuits with concentrated parameters. The diakoptic analysis of electromagnetic systems is based on the diakoptic splitting of the original problem to subproblems and surface formulation of equivalence theorem, that is the basis for surface formulation of method of moments, too. Since the diakoptic approach and the surface formulation of method of moments share the same theoretical basis, the diakoptic approach can be seamlessly integrated into existing codes for the numerical analysis of electromagnetic systems that are based on integral-equation formulation and the equivalence theorem. In comparison to classical MoM analysis, the proposed diakoptic approach can accelerate the analysis and significantly decrease the computer resources, in particular the memory needed for storing the matrices during the analysis. Therefore, it is possible to increase the size and complexity of the electromagnetic system that can be solved with the given hardware by using the diakoptic approach. One of the goals of this thesis is to show the efficiency of the diakoptic approach applied to electrostatic and electrodynamic problems. In 1st chapter of the thesis is briefly described the significance of the electromagnetic analysis of large and complex electromagnetic systems. In 2nd chapter is given the outline of basic ideas of well known and often referenced methods for acceleration of electromagnetic analysis. The accent is on methods that are directly or indirectly linked to the diakoptic analysis. In 3rd chapter is outlined the equivalence theorem that is the basis of the diakoptic analysis, and the sufficient condition for its validity. The accent is on the surface formulation of the equivalence theorem since it is the core of the diakoptic approach. In 4th chapter is given the theoretical description of the diakoptic approach and the accompanying terminology. After that, in the next four chapters are given the characteristic examples of the diakoptic approach applied to 2-D and 3-D electrostatic and electrodynamic problems. In the end, in 9th chapter are given the conclusions about the benefits and limits of the proposed diakoptic approach. Moreover, mentioned are several possibilities for further refinement and applications of the diakoptic approach, as well as directions for further increase of the efficiency that can be achieved. Finally, several directions for further research of the diakoptic approach are mentioned.