Methods of Macromodelling and Diakoptic for Creation of Mathematical Models of Electric Power Systems and Their Elements

Petro Stakhiv, Oksana Hoholyuk

Abstract - **In the paper the problem of electric power system transients is considered based on approaches of macromodelling and diakoptic. Detailed mathematical models and macromodels of separate electric power systems elements are described and approaches of the combined usage are presented.**

Keywords - **Mathematical macromodel, transient process, diakoptic, electric power system.**

INTRODUCTION

At present moment the theory of mathematical modeling has been changed that can have essential influence on usage of traditional approaches of calculation of dynamic regimes in electric circuits, especially electric power systems. First of all it concerns the usage of discrete mathematical models in order to describe processes in dynamic systems. Applying of decomposition, diakoptic and macromodelling and their implementation on multiprocessor computers is a perspective trend in development of mathematical models of electric power systems.

II. MATHEMATICAL MODEL OF ELECTRIC POWER SYSTEMS WITH MACROMODELS

So, in order to mentiooned higher problems it can be proposed to use mathematical models of researched circuits with associated discrete equivalent circuits [1], but in contrast to the classic approach a discrete description (macromodel) of separate subcircuits is used here. In electric power systems it can be macromodels of transformers, substations, turbogenerators, or even the whole electric station. Such approach makes it possible to exclude from mathematical model of the system the raw of variables which are not interesting for the researcher at some stage. As a result, it can essentially simplify the model and accelerate calculations. The absence of the discretization stage necessary for traditional approaches reduces the time of calculation too.

Diakoptic approach is perspective for the macromodels usage because it allows to analyze no homogeneous electric circuits which can contain components both with lumped and distributed parameters. Besides it, diakoptic approach allows to implement calculations using parallel structures [2] that means calculation in real time mode for electric power systems and to conduct a prognosis of their behavior.

Petro Stakhiv, Oksana Hoholyuk - Lviv Polytechnic National University , S. Bandery Str., 12, Lviv, 79013, UKRAINE, E-mail: spg@polynet.lviv.ua, oph@polynet.lviv.ua

At the modern stage of simulation of complex electric circuits it is possible to define several types of electric circuits macromodels. During electric power system simulation the circuit macromodels are most widely used (they are macromodels with the circuit reduction), mathematical macromodels and symbolic macromodels [1,3].

The advantages of implementation of the discrete state equation as means for mathematical description of macromodels and adaptation of such type macromodels to computer environments intended for electric system transients processes modeling. A raw of specific features which have a strong influence on construction procedure of macromodel creation for elements of electric power systems were analysed in details. The procedure of the macromodel creation consisting of several stages and its features for different type elements was developed.

The test examples of macromodel creation for separate electric power system elements are considered, namely power transformer and turbogenerator. Comparing of obtained macromodels with their traditional maodels for the transient processes analysis was carried out.

The problem of composition of macromodels of separate elements with traditional mathematical model of electric power system and an approach how to implement such computer model were considered.

III. CONCLUSIONS

So, in the presented paper the possibility of discrete mathematical macromodels usage for electric power system elements analysis during calculation of their dynamic modes and their simultaneous usage with mathematical models of other elements is shown.

REFERENCES

[1] Стахів П. Г. Макромоделювання та діакоптика як засіб підвищення ефективності розрахунку складних електротехнічних систем //*Технічна електродинаміка, тематичний випуск "Проблеми сучасної електротехніки"*.- Ч. 6., Київ, 2000.-с. 9-14

[2] P. Stakhiv, S. Rendzinyak, B. Krupskyy, “Parallelization of Diacoptic Methods for Multiprocessor Computing Systems”, *Bulletin of the Polish Academy of Sciences, Technical Sciences*, Vol. 51, No. 4, 2003, pp. 381-394

[3] Kayssi A. Macromodel Construction and Verification// *Circuits and Devices Magazine*, IEEE Vol. 14, Issue 3, May 1998,pp. 34 – 39.