

The completed scientific and research № 2115-p “Methods of Automatic Circuit Macro-models Micro-electromechanical Systems”. (Institute for Applied System Analysis — Research Advisor A.I.Petrenko)

The main methods and algorithms for the reduction of MEMS mathematical models in terms of their efficiency, the possibility of adaptation to existing CAD packages including circuit design, and use for objects of extra large dimensions (including hundreds of thousands of components) have been analysed. It has been suggested to use an approach based on an extended basis homogeneous coordinate and Y- Δ transformation as the main approaches for building effective procedures to reduce the MEMS mathematical models dimensions and MEMS macro-models design.

The algorithms for circuit analogues of mathematical models of MEMS non-electric units have been studied and modifications that take into account “non standard” numerical situation (finiteness of bit computer network, the over difference in the values of matrices C, G, L elements) have been suggested.

The algorithm for reducing RLC circuit mathematical models based on Y- Δ transformation, which is different from the current strategy of the choice of excluding sites sequence that ensures minimal loss of accuracy and a wider set of formulas for the calculation and identification of semiconductors types,(the letter appearing in the process of nodes exclusion and methodology of their obtaining) has been introduced.

It was experimentally proved that the studied method of circuit implementations of non-electric facilities models in conjunction together with the developed method of reduced size of RLC circuits can be effectively used for receiving macromodels of non-electrical MEMS components. The results show that the accuracy of a complete equivalent circuit model does not yield the accuracy of mathematical models based on finite element method, and accuracy obtained MEMS macromodels lies within engineering error (1-10%). At the same time it is possible to operate both the accuracy of obtained macromodels and their size.

Developed approaches and methods of high accuracy of MEMS macromodels constructions have been implemented in the form of parallel computing algorithms and adapted to the complex circuit design NetALLTED (Kyiv, NTUU “KPI”).

The results of the theoretical and research work have been implemented in the new chapters of “MEMS Macromodelling Method” and “Parallel Algorithms for Reducing the MEMS Size”, in educational subjects “Fundamentals of Parallel Computations” and “Fundamentals of Computer Aided Design of Complex Objects and Systems” at the Department of SD, IAS of NTUU “KPI”, and also in the process of diploma researches, and in case of applying for master’s programs in the field of “Collective Computer Design in the Internet Network” at ESC “IASA”.

The results of the research have been used to create circuit macromodels of mechanical systems range under the project agreement with the Ukrainian Scientific-Technological Centre (USTC) №3278/840/2700-4 “Development of Methodology and Design Tools Used in the Internet Network with a Focus on Micro Electromechanical Systems (MEMS)”.

As a result of the performed work two theses have been prepared to defend, 20 articles have been published, 10 reports have been made at conferences, including 8 at the international ones. 10 students have been involved in the research work. According to the research results students have defended 3 master's thesis and 3 diploma projects.