

Abstract

of attestation master's degree work subject:

«Research of methods for constructing non-electrical components of circuit equivalents
macromodels of MEMS»

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Actuality of work

Microelectromechanical systems (MEMS) are a field of modern technology, which is developing rapidly. But at the design of modern devices, the important role played by the possibility of using the same tools for modeling objects with blocks of different physical nature. This requires the submission of all subsystems in the form of equivalent models of the same nature. At the stage of circuit design the method of electromechanical analogies is used to create a mathematical model of the object design of complex physical nature. But this requires a circuit realization of models of non-electric units. Most CAD systems are used for the design of mechanical systems, for the construction of the mathematical model is used the finite element method. However, the main problem in this - the huge size of mathematical models reaching hundreds of thousands of equations. The only possible solution of this situation is to reduce the dimension of mathematical models of MEMS and getting its scheme- theoretic analogue of a macro model. Therefore, the development and study of the effectiveness of methods for constructing circuit equivalents of non-electrical components macromodels of MEMS is a fairly urgent problem.

The purpose of work

The purpose of work is to study the features of the algorithm Y- Δ transformations for the construction of non-electric circuit equivalents macromodels of MEMS components in terms of accuracy and time for results, building on this basis, affective procedures for selection algorithm downsized units, and develop recommendations to refine the parameters of macromodels obtained with the help of optimization procedures.

Tasks solved in work

1. Research features of existing algorithms to reduce the size of mathematical models of complicated objects.
2. Research features of individual phases of Y- Δ transformation, which most »affect the time of receipt of results, and the final error.
3. Design and experimental investigation of effective modifications of the | algorithm of choice downsized units.
4. The influence of the number of parameters that are changeable, the size of the I possible range of their existence, and the sample size on the effectiveness of the method of random search with a decrease in the interval to refine your search circuit implementation of macromodels non-electrical components of MEMS.
5. Development of recommendations to clarify the parameters of macromodels obtained with the help of optimization procedures package ALLTED.

The achieved results

Solving the tasks put in-process, an author protects: results of analysis of individual steps in the procedure Y- Δ transformation for the construction of circuit equivalents of non-electric macromodels of MEMS components that determine the ultimate accuracy macromodel and time of receipt;

- two modifications (modification of 2 and 3) selection algorithm downsized units to allow a significant decrease in the number of elements in the Y- Δ transformation and do not lead to an increasing error;
- results of the study the effectiveness of the proposed modification of the algorithm of choice in downsizing nodes by constructing analog circuit macromodels four mechanical units;
- the influence of the quality, number of variable parameters, the size ranges of their variation and sample size on the efficiency of solving the parametric optimization of macromodels non-electrical components of MEMS using the method of random search with a decrease in search interval.

- recommendations for the use of block optimization package ALLTED to refine your analog circuit macromodels mechanical components of MEMS.

Scientific novelty

The scientific novelty of work consists in the following:

- identified and analyzed the individual steps of the procedure Y- Δ transformation for the construction of non-electric circuit equivalents macromodels of MEMS components that determine the ultimate accuracy macromodel and time of receipt;
- developed two versions (option 2 and 3) selection algorithm downsized units to allow a significant reduction of the number of elements in the Y- Δ transformation and does not lead to an increase in errors, which differ from existing ones:
- method of determining the set of nodes at each step of the Y- Δ transformation, which may be subject to reduction. criteria for choosing the site, subject to the reduction of many possible.
- developed recommendations to clarify the parameters of macromodels obtained with the help of optimization procedures package ALLTED.

Practical value

Practical value of work consists in the following:

- experimentally investigated and proved the effectiveness of the proposed modifications of the algorithm of choice in downsizing units;
- the effect of varying parameters, the size of the possible range of their existence, and the sample size on the effectiveness of the method of random search with a decrease in the interval to refine your search circuit implementation of macromodels nonelectrical components of MEMS.

Conclusions

1. Analyzed The basic methods and algorithms to reduce the size of mathematical models of non-electrical components of MEMS in terms of their effectiveness, ability to adapt to existing

CAD systems, such as packages of circuit design, user interface objects for very large-scale dimension.

2. Analyzed the features of the procedure Y- Δ transformation for the construction of non-electric circuit equivalents macromodels of MEMS components and identified the individual stages, which determine the ultimate accuracy macromodel and time of receipt. Offered two versions (option 2 and 3) selection algorithm downsized units to allow a significant decrease in the number of elements in the process Y- Δ transformation and do not lead to an increase in error.

3. Experimentally, the examples of constructing circuit analog macromodels four mechanical units, we have proved the effectiveness of the proposed modification of the algorithm of choice downsized units.

4. Experimentally, by a solution of test problems of optimization of circuit analog macromodels mechanical components of MEMS, the influence of quality, number of variable parameters, the size ranges of their variation and sample size on results of test problems using the method of random search with a decrease in search interval were investigated.

5. The recommendations on the use of block optimization package ALLTED to refine your analog circuit macromodels mechanical components of MEMS.

The work contains 113 pages, 43 images, 36 tabl., 33 sources.

Keywords: MICROELECTROMECHANICAL SYSTEMS, Y- Δ TRANSFORMATION, ALLTED, PARAMETRIC OPTIMIZATION, MACROMODEL.