Simulation of quasi-periodic processes in dynamic systems based on optimization approach

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Abstract **the simulation of quasi-periodic processes in dynamic systems based on optimization approach is considered in this article on the example of oscillator macromodel construction. The analysis of peculiarities of optimization approach application for both the case of quasi-periodic regimes simulation and the case of non-zero initial state of the simulated object has been performed.**

Keywords **Mathematical models, optimization, nonlinear dynamical system.**

I. INTRODUCTION

An essential part of electrical systems design process is the use of computer tools for simulation of the designed system behavior in different modes. Effective utilization of those computer simulations, in turn, depends on the completeness of the used models library and on the accuracy and simplicity of the models. This makes it necessary to develop universal approaches for mathematical models construction.

One of the promising approaches for macromodels construction in terms of universality is the use of optimization. Values of macromodel coefficients in this approach are found by minimization of some goal function, which represents the inaccuracy of the object behavior simulation using the model being constructed. This function is calculated using the available information about the object and is assumed to be a function of the coefficients describing the constructed model.

By finding the point in the parameter space where the goal function reaches its minimum we immediately find the optimal values of the model coefficients which correspond to the chosen mathematical form of the model representation, to available information about the object and to the comparison criterion used to define the goal function.

Described approach can be used for the construction of macromodels in any mathematical form with a limited set of coefficients. It also does not apply any limitations on required information about the object except the obvious requirement to describe it fully enough. Furthermore, the use of optimization eliminates the calculation problems related to the fact, that mathematical model identification is often an ill-conditioned problem.

The main problem which precludes the wide usage of the optimization approach is complexity of optimization task, which requires significant computation resources.

II. PECULIARITIES OF QUASI-PERIODIC PROCESSES SIMULATION

Quasi-periodic processes simulation takes a special place among the modeling problems. These processes are interesting because of their widespread use, on the one hand, and the complexity of existing models and the means of their creation, on the other.

In the quasi-periodic processes simulation, quite often there is a situation when zero initial state of the system cannot be assumed. This is particularly the case for modeling of autonomous systems and for prediction tasks. The behavior of such systems depends on their initial state. Thus we can assume that the initial state of the system plays a role of input variables.

Owing to its universality, the optimization approach for macromodel construction can be adapted to take into account this dependency on the initial state of the system [4].

An attempt to apply this approach for the simulation of quasi-periodic processes in dynamical systems is presented in this paper on the example of construction of a model for signal generator.

In case if we are not interested in the process of starting the generator, but only in its response to load changes, we have the aforementioned dependence on the initial state of the simulated object.

III. CONCLUSION

The obtained model of the generator that allows accurate simulation of the change in the generated signal parameters caused by the change in its load demonstrates that optimization approach can be used to simulate the quasi-periodic processes in dynamic systems.

IV. REFERENCES

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