FEATURES OF SYNTHESIS OF AUTOMATIC CONTROL SYSTEMS BY INTEGRAL QUADRATIC ESTIMATES

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The paper deals with the peculiarities of numerical synthesis of automatic control systems (ACS) based on improved integral quadratic estimates (IQE). It is emphasized that even for third-order systems the problem of minimizing the IQE requires the use of numerical optimization methods. Practice has shown the high efficiency of the step adaptation method for one-dimensional search and the Nelder-Mead and Broyden-Fletcher-Golfarb-Shanno (BFGS) methods for multidimensional problems [1, 3].

The effectiveness of the approaches is demonstrated on the examples of second- and third-order ACS. It is noted that when choosing an excessive initial step, the optimization process may go beyond the boundaries of the stability region, where the target function may take incorrect (negative) values.

It is shown that classical numerical methods do not always provide the search for a solution in the admissible region of parameters. To eliminate this disadvantage, we propose a modification of optimization methods by introducing a vector target function and comparison operations that allow us to take into account the stability of the system at each search step. The developed methods provide: control of the stability region during optimization, reduction of the probability of obtaining incorrect solutions, achievement of the minimum of IQE with a given accuracy on variable parameters.

Numerical experiments have confirmed that the application of vector target function and search point comparison algorithm allow to effectively minimize IQE, avoiding the exit from the stability region. The results can be used in the automated synthesis of ACS with specified quality indicators [2].

References:
1. Usyk A. Y., Severin V. P. Methods of synthesis intelligent automatic control systems for power units of electric power plants // Computer science, management and artificial intelligence: Abstracts of the XI International Scientific and Technical Conference, 9-12 May 2024 - Kharkiv, NTU "KhPI" - 2024. - P. 137.
2. Usyk A. Y., Severin V. P. Optimal synthesis of intelligent information control systems of a nuclear power plant power unit for manoeuvrable operating modes // Information technology: science, engineering, technology, education, health: Abstracts of the XXXII International Scientific and Practical Conference MicroCAD-2024, 22-25 May 2024 - Kharkiv, NTU "KhPI" - 2024. - P. 1232.
3. Usyk A. Y., Severin V. P. Parametric synthesis of intelligent information control systems by optimization methods // Theoretical and practical research of young scientists: Abstracts of the XVIII International Scientific and Practical Conference of undergraduate and graduate students, 19-22 November 2024 - Kharkiv, NTU "KhPI" - 2024. - P. 40.