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OPTIMIZATION OF DISCRETE SYSTEMS IN THE PRESENCE OF LIMITATIONS ON SENSITIVITY

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The results of calculation of stability regions for optimization problems with limited sensitivity. For linear discrete systems considered statement of problems the guaranteed sensitivity covered algorithms practical stability.

Discrete system, limited sensitivity, parameters, practical stability.

The problem of efficiency system in real covers a number of problems associated with the analysis and evaluation of the relative sensitivity disturbances. Typically, the process control system is carried out in real conditions of uncertainty, due to various reasons, including the presence of inaccurate given external perturbation errors in the performance management programs, measurement errors in the channel and more. The result is inconsistency mathematical models of physical objects, to describe which it serves. Therefore, when designing a real system it is necessary to take into account the requirements for robustness (stability) of the model relatively uncertain factors. To test the sensitivity often choose to limit the dynamic function of sensitivity, which is a quantitative measure of the effectiveness of management on the basis of feedback. Statement of the problem of limited sensitivity covered algorithms of practical stability in the space of functions of sensitivity.

The purpose of research ─ development of effective methods for calculating areas of stability of discrete systems for tasks with limited sensitivity and guaranteed.

Materials and methods research. The paper used methods of the theory of stability, sensitivity, control theory and optimization.

Let the motion of the object is described by a discrete nonlinear system equations like

$$x_{i+1} = f_i(x_i, \alpha), \quad f_i(0,0) = 0, \quad i = p_0, p_0 + 1, \ldots, P - 1 \qquad (1)$$

in the presence of initial conditions $x_{p_0} = x_0(\alpha)$. Then, if right part of the original system are continuous with the partial derivatives in x_i, α $(i = p_0, p_0 + 1, ..., P)$, there are vectors sensitivity functions $u_i^j(\alpha) = \frac{\partial x_i(\alpha)}{\partial \alpha_j}$, $j = 1,2,...,m$, $i = p_0, p_0 + 1, ..., P$ – solutions of the Cauchy problem.

Consider the problem of minimizing the functional of the final state of the system (1) vector of parameters α

$$I(\alpha^0) = \min_{\alpha \in G_\alpha} \Phi(x_P(\alpha)) \qquad (2)$$

at presence of dynamic constraints on the function of sensitivity.

To minimize the functional (2) use the method of gradient projection. To take account of the requirements for sensitivity functions for fixed α^k, $k = 0,1,2,...$, apply algorithms practical stability [2] in the space of these functions. For this purpose we shall set region of initial conditions in structural form $G_0 = \left\{ u_{p_0}(\alpha) : \sum_{i=1}^{m} u_{p_0}^{j*} B_j u_{p_0}^j \le c^2 \right\}$, where B_j, $j = 1,2,...,m$ – known positively identified square matrix of dimension m.

In order to limit the function of sensitivity were performed for each arbitrary value α, you need to build an appropriate set of linearized system (1).

The proposed approach can be used to assess the parameters of tolerance in the presence of constraints on the variation of the phase coordinate system.

Results. For discrete parametric systems implemented numerical solution of problems of limited sensitivity and guaranteed methods of practical stability.

Conclusions

Based on practical algorithms for discrete systems stability methods of estimation developed by regions of initial conditions for sensitivity functions associated with designing insensitive systems.

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Приведены результаты расчета областей устойчивости для оптимизационных задач с ограниченной чувствительностью. Для линейных дискретных систем рассмотрены постановки задач гарантированной чувствительности, которые охватываются алгоритмами практической устойчивости.

Дискретная система, ограниченная чувствительность, параметры, практическая устойчивость.

Наведено результати розрахунку областей стійкості для оптимізаційних задач з обмеженою чутливістю. Для лінійних дискретних систем розглянуто постановки задач гарантованої чутливості, що охоплюються алгоритмами практичної стійкості.

Дискретна система, обмежена чутливість, параметри, практична стійкість.