RESEARCH PROBLEMS LIMITED SENSITIVITY OF THE METHOD PRACTICAL STABILITY

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The results of calculating the areas of stability for sensitivity functions defined structures in the presence of dynamic constraints. The problem of limited sensitivity and guaranteed covered algorithms practical stability.

Functions sensitivity, parameters, perturbed trajectory, practical stability.

Problem sensitivity is directly related to evaluating the impact of disturbances on the performance of the real dynamic system and covers a number of problems of different nature [1,2]. Often it is advisable to sensitivity analysis using sensitivity functions, defined as derivatives of functions of the state of the parameters under certain requirements for differentiation. This approach applies to class of problems limited and guaranteed sensitivity optimization productions including proposed methods to solve practical stability [3,4].

The purpose of research – development of effective methods for calculating areas of initial conditions for problems of limited sensitivity and guaranteed methods of practical stability.

Materials and methods research. The paper used mathematical methods of parametric stability based on the method of comparison in the qualitative theory of differential equations.

Suppose that for some of the principles defined the structure of the real system in the form of a parametric model that quite objectively reflects its basic properties, including the possible dependence on the parameters.

Let nonlinear dynamic object described by a system of differential equations:

$$\frac{dx}{dt} = f(x,t,\alpha), \quad f(0,t,0) \equiv 0, \quad t \in [0,T] \qquad (1)$$

with initial conditions

$$x(t_0) = x_0 = x_0(\alpha),\ t_0 = t_0(\alpha), \tag{2}$$

Designating through P_x a set of desired states of the object, and after $R_x(\alpha)$ − the set of its real condition corresponding parameter value α, write a normal performance in the form of:

$$R_x(\alpha) \subseteq P_x,\ \alpha \in G_\alpha . \tag{3}$$

Sometimes the desired condition of the object (3) provide convenient as follows:

$$R_J(\alpha) \subseteq P_J,\ \alpha \in G_\alpha , \tag{4}$$

where $R_J(\alpha)$ − set some functional defined on the set of vector states; P_J − the set of admissible states of functionality.

For specifying the conditions described system health (1) use the concept of sensitivity functions [1]. Subject to certain conditions, continuity and differentiation sensitivity functions are special solutions of the Cauchy problem (for each value α) derived by direct differentiation of the original system (1).

If the variation in the value parameter vector in the vicinity of the estimated value $\bar{\alpha}$ is relatively small in magnitude, then the approximate equality:

$$x(t,\bar{\alpha} + \Delta\alpha) \approx x(t,\bar{\alpha}) + U(t,\alpha)\big|_{\alpha=\bar{\alpha}} \cdot \Delta\alpha , \tag{5}$$

where $U(t,\alpha)\big|_{\alpha=\bar{\alpha}}$ − sensitivity matrix functions with elements $u_i^{(j)}(t,\alpha)$ of dimension $n \times m$, calculated at the point $\alpha = \bar{\alpha}$. In view of (5) to reject the expression becomes:

$$\Delta x(t,\alpha) = \sum_{j=1}^{m} u^{(j)}(t,\bar{\alpha})\Delta\alpha_j .$$

You can also add and expression to reject quality.

To obtain a common practice objectives of sensitivity theory, we distinguish the productions (3), (4) the class of problems under the form:

$$R_x(\alpha) \subseteq P_x,\ R_u(\alpha) \subseteq P_u,\ \alpha \in G_\alpha ; \tag{6}$$

$$R_J(\alpha) \subseteq P_J,\ \bar{R}_u(\alpha) \subseteq \bar{P}_u, \alpha \in G_\alpha . \tag{7}$$

Here $R_u(\alpha)$, $\overline{R}_u(\alpha)$ − a set of sensitivity functions corresponding to a particular value parameter vector α; P_u, $\overline{P}_u$ − set the desired sensitivity function.

Statement of the problem (6), (7) the class of problems relating to design systems with limited sensitivity, and simple sensitivity analysis here may be to test these relationships for the calculated value $\alpha = \overline{\alpha}$. This problem (7) covers setting and optimization of the requirements for the sensitivity. To set restrictions were performed at each step iterative procedure optimization employ a method of practical stability parametric systems in space function sensitivity.

From these positions can be approached to the problem of guaranteed sensitivity to initial nonlinear system (1), making its linearization in the vicinity of the settlement movement.

Results. Done formalization overall performances of common problems of the theory of sensitivity. For the continuous case of parametric numerical estimates obtained calculation problems limited sensitivity and guaranteed methods of practical stability.

Conclusions

Based on practical criteria for stability of parametric estimation algorithms developed regions of initial conditions for sensitivity functions associated with designing tolerant control systems.

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Приведены результаты расчета областей устойчивости для функций чувствительности в заданных структурах при наличии динамических ограничений. Рассмотрены постановки задач ограниченной и гарантированной чувствительности, которые охватываются алгоритмами практической устойчивости.

Функции чувствительности, параметры, возмущенная траектория, практическая устойчивость.

Наведено результати розрахунку областей стійкості для функцій чутливості у заданих структурах за наявності динамічних обмежень. Розглянуто постановки задач обмеженої та гарантованої чутливості, що охоплюються алгоритмами практичної стійкості.

Функції чутливості, параметри, збурена траєкторія, практична стійкість.

The results of the calculation of stability regions for sensitivity functions defined structures in the presence of dynamic constraints. Considered problem statement and a guaranteed limited sensitivity covered algorithms practical stability.

Features sensitivity, parameters, perturbed trajectory, practical stability.