INSTABILITY OF PROGRAM MANIFOLD, WITH A COMPACT NEIGHBORHOOD OF CONTROL SYSTEMS

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The problem of determining the instability of the program manifo0ld of automatic control systems, with a compact neighborhood is investigated. The sufficient conditions of absolute instability of the program manifold, which has a compact neighborhood are obtained by means of construction of the infinitely small upper limit Lyapunov function.

We consider the problem of construction of the stable automatic control systems by given program manifold $\Omega(t) \equiv \omega(t,x) = 0$ [1]:

$$\dot{x} = f(t,x) - B\xi, \quad \sigma = P^T\omega, \quad t \in I = [0,\infty), \tag{1}$$

where $x \in R^n$ is a state vector of the object, $f \in R^n$ is a vector-function, satisfying to conditions of existence and uniqueness of a solution $x = x(t)$, $B \in R^{n\times r}$, $P \in R^{s\times r}$ are matrices, $\omega \in R^s$ $(s \le n)$ is a vector, $\xi \in R^r$ is a vector-function of control on deviation from the given program manifold

$$\varphi^T\theta\left(\sigma - K^{-1}\varphi\right) > 0, \theta = diag\|\theta_1,\ldots,\theta_r\|, K = K^T > 0. \tag{2}$$

Taking into account that Ω is the integral manifold of the system (1), and assuming $F(t,x,\omega) = -A\omega$ we have

$$\dot{\omega} = -A\omega - HB\xi, \xi = \varphi(\sigma), \sigma = P^T\omega, H = \frac{\partial\omega}{\partial x}. \tag{3}$$

where $F(t,0,u) \equiv 0$ is Erugin's s -vector-function [2].

Definition 1. A program manifold $\Omega(t)$ with a compact neighborhood is called instable on the whole in relation to vector-function ω, if in phase space there is an unlimited open area Ξ, including a neighborhood of the given program manifold and possessing that property, that all solutions in relation to vector-function ω beginning in this area, unlimited at $t \to \infty$.

Definition 2. A program manifold $\Omega(t)$ with a compact neighborhood is called absolutely instable in relation to vector-function ω, if it is instable on the whole at all functions $\varphi(\sigma)$ satisfying to the conditions (2).

Problem Statement: To obtain the condition for absolute instability of program manifold with a compact neighborhood $\Omega_\varepsilon(t)$ of automatic control systems.

To construction of the systems of equations for a given variety, possessing the properties of stability, optimality and establishing evaluation indicators of quality of the transition process in the neighborhood of program manifold, devoted a lot of work. A review of these works carried out in [3 - 5].

We will investigate a case, when $\|\omega\| = \rho(x, \Omega(t))$.

Theorem. The program manifold of automatic control systems (1), with a compact neighborhood $\Omega_\varepsilon(t)$, is absolutely instable if the following conditions are hold, at all functions $\varphi(\sigma)$ satisfying to the conditions (2)

$$l_1(h)R^2 \le V \le l_s(h)R^2, R^2 = \|\omega\|^2, \tag{4}$$

$$-\gamma_1\left(\|\omega\|^2 + \|\varphi\|^2\right) \le z^TQz \le -\gamma_{s+r}\left(\|\omega\|^2 + \|\varphi\|^2\right), z = \begin{Vmatrix}\omega\\ \varphi\end{Vmatrix}. \tag{5}$$

References

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