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**SYNTHESIS OF ROBUST CONTROL SYSTEMS
OF LINEAR OBJECT WITH DELAY IN THE FOOD INDUSTRY**

The task of constructing an optimal robust control in a feedback on the state of linear dynamic system is to minimize the quadratic integral-functional disturbances under the most adverse system. The real objects and controls are nonlinear functions in the face of uncertainty associated with the delay object control. The task of managing such objects receives much attention. Solution to the problem of building robust linear control system, which is influenced by perturbations of unknown nature, in terms of delay is proposed.

The dynamics of the object can be described as follows in the management and external disturbances

$$\begin{aligned} \dot{x} &= A(t)x(t) + B(t)u(t) + K(t)f(t), & 0 < t < T, \\ x(0) &= Lf_0, \end{aligned} \tag{1}$$

where $x(t) \in R^n$ – state vector, $u(t) \in R^m$ – vector control, $f(t) \in R^r$ – unknown vector of external disturbances acting on the system, $f_0 \in R^r$ – also unknown vector disturbing system, T – the initial time, $A(t) \in R^{n \times n}$, $B(t) \in R^{n \times m}$, $K(t) \in R^{n \times r}$, $L \in R^{n \times r}$ – set matrix.

There is the problem of finding the optimal control satisfying condition

$$J(u) = \min_{u} \int_0^T I(u, f) dt, \tag{2}$$

where $I(u, f)$ – integral – quadratic optimality criterion

$$I(u, f) = (Hx(T), x(T)) + \int_0^T ((G(t)x(t), x(t)) + (D(t)u(t), u(t))) dt,$$

where $H = H^T > 0$, $G(t) = G^T(t) > 0$, $D(t) = D^T(t) > 0$ – set matrix.

Hamiltonian function $H(x, v, w, X)$ with terms of minimization (maximization) is build for solution based on the principle of Pontryagin. The $v(w)$ gives matrix of Riccati type differential equation. The solution of Riccati type differential equation gives the best value for the functions $v(t)$ and $w(t)$

$$v^*(t) = -B^T(t)P(t)x(t), \quad w^*(t) = \frac{A^T K^T(t)P(t)x(t)}{Y} \tag{3}$$

The value of functional calculations after missing intermediate solution could be described as follows

$$JY(v^*, w^*) = w^T \{L^T w P(0) L w - Y^2 E\} w_0 \tag{4}$$

KEY WORDS: optimization problems, nonlinearity, delay, Hamiltonian, Riccati equation