ON APPROACH TO THE FEEDBACK CONTROL FOR DISTRIBUTED SYSTEMS

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An approach to solving the problem of feedback control of lumped sources for objects with distributed parameters is investigated:

$$u'_t \equiv L\Big(\frac{\partial}{\partial x}\Big)u + \sum_{i=1}^{l} q_i(t)\delta(x - x^i), \quad x \in \omega \subset E, \qquad t \in (0, T],$$

where L is the differential operator; $u = u(x,t)$ is the function describing the phase state of the object; $q_i(t)$ are control influences lumped at points $x^i \in \Omega$; relations

$$N\Big(\frac{\partial}{\partial x}\Big)\,|_{t=0} \in Q(x), \qquad M\Big(\frac{\partial}{\partial x}, t\Big)\,|_{x\in\Gamma} \in C_\Gamma(t),$$

at given $C_\Gamma(t), Q(x)$ determine possible initial-boundary conditions, where M, N are the differential operators and Γ is the boundary of ω. A criterion of quality of control by object is given $J(q(t), u(x,t))$.

Feedback control is performed with the use of state feedback, namely on the basis of constant tracking of phase state at definite points of the object. Feedback control functions are from the class of piece-wise constant functions. The regions of constancy of control values are predefined pair-wise disjoint subsets (zones) of the values of phase state space at the observable points of the object:

$$\begin{aligned} q_i(t) = q_i^j \quad &\text{for} \quad (u(x^1,t), \ldots, u(x^l,t)) \in \Omega^j \subset E^{l\times n} \\ \Omega^{j_1} \cap \Omega^{j_2} = \emptyset \quad &\text{for} \quad j_1 \neq j_2. \end{aligned}$$

The aggregate of all subsets Ω_i constitutes the set of possible phase states of object at the observable points under all possible admissible control values and initial-boundary conditions of the problem.

The considered feedback control problems are reduced to finite-dimensional parametric optimal control problems. The specific character of these problems lies in its large dimension and possible multiextremal feature even in the case of convex original problem. Necessary conditions of local optimality of feedback control are obtained in the paper. The results of numerous computational experiments and its analysis are given.