OPTIMIZATION OF HYBRID SYSTEM WITH VARYING INITIAL STATE

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Hybrid system under consideration belongs to the class of switched linear autonomous systems which characterizes by multiple modes for system's dynamics and switching conditions described transitions between the modes [1]:

$$\dot{x} = A_i x + b_i u, \quad \theta_{i-1} \le t < \theta_i, \ i = \overline{1, L},$$

$$h_i' x(\theta_i) = g_i, \ i = \overline{1, L},$$

$$0 = \theta_0 < \theta_1 < \cdots < \theta_{L-1} < \theta_L = t^*,$$

where $x, b_i, h_i \in R^n$, $u, g_i \in R$, $A_i \in R^{n\times n}$, $i = \overline{1, L}$; $T = [0, t^*]$ is a control interval.

As accessible controls discrete functions $u(t) = u(\tau)$, $\tau \in T_h = \{0, h, \ldots, t^* - h\}$, are considered, where $h = t^*/N$ is a sampling period, N is an integer.

The problem is to maximize a value of the linear endpoint performance index over initial state x_0, bounded control function $u(\cdot) = (u(t),\ t \in T)$, and switching instants $\theta = (\theta_1, \ldots, \theta_{L-1})$:

$$J(x_0, u(\cdot), \theta) = c' x(t^*) \longrightarrow \max,$$

$$\dot{x} = A_i x + b_i u, \ t \in [\theta_{i-1}, \theta_i), \ i = \overline{1, L}, \tag{1}$$

$$x(0) = x_0 \in X_0 = \{z \in R^n : Gz \le \delta, d_* \le z \le d^*\},$$

$$h_i' x(\theta_i) = g_i, \ i = \overline{1, L}, \quad |u(t)| \le 1, \ t \in T,$$

where X_0 is a set of admissible initial states, $G \in R^{k\times n}$.

Algorithms of constructing open-loop and closed-loop solutions to problem (1) are suggested. The algorithm of open-loop optimization of systems (1) is based on the approach to the solution of linear optimal control problems with the use of advanced linear programming technique [2].

Constructing of positional solution to problem (1) is investigated in the framework of the approach to the optimal synthesis problem [2, 3] based on real-time correction of open-loop solutions subject to small variations of current position. Features of the algorithm of realization of positional solution to problem (1) are discussed.

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References

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