Decomposition of Discrete Linear-Quadratic Optimal Control Problems for Two-Step Descriptor Systems

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Abstract: The most part of publications devoted to multi-step systems deals with continuous-time systems. We consider here discrete linear-quadratic optimal control problems for two sequentially acting descriptor controlled systems. Matching conditions for trajectories at the switch point are absent, however the minimized functional depends on values of a state trajectory at the left and right sides from the switch point. Some components of state trajectories at the left and right points are fixed. The similar problem for continuous systems has been considered in: G.A. Kurina, 50th IEEE Conference on Decision and Control and European Control Conference (CDC-ECC), Orlando, FL, USA, (2011), 6705–6710.

We derive sufficient control optimality conditions in the maximum principle form. The solvability of the considered problem is established. Under some conditions the algorithm for solving the problem is given, which is based on sequential solving some initial value problems. The formula for the minimal value of the performance index is also obtained.

In a special case where the number of argument values is odd and the switch point is situated in the center, the transformation reducing the discrete optimal control problem for descriptor systems with an intermediate point to a problem without one is presented.

To demonstrate the efficiency of the proposed algorithms the illustrative examples are given.

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