KYBERNETIKA — VOLUME 37 (2001), NUMBER 1, PAGES 1-20

Periodic Systems Largely System Equivalent to Periodic Discrete-Time Processes

Sauro Longhi; Osvaldo Maria Grasselli; Antonio Tornambé

Abstract: In this paper, the problem of obtaining a periodic model in state-space form of a linear process that can be modeled by linear difference equations with periodic coefficients is considered. Such a problem was already studied and solved in [20] (O.M. Grasselli, S.Longhi, and A.Tornambè: System equivalence for periodic models and systems. SIAM J. Control Optim. 33 (1995), 2, 544–468.) on the basis of the notion of system equivalence, but under the assumption that the process has no null characteristic multiplier. In this paper such an assumption is removed in order to generalize the results in [20] to linear periodic processes with possibly the null characteristic multiplier (e. g., multirate sampled-data systems). Large system equivalence between two linear periodic models of such processes is introduced and analyzed. For a given linear periodic process the necessary and sufficient conditions are found for the existence of a linear periodic system (i. e., a linear periodic model in state-space form) that is largely system equivalent to the given model of the process, together with an algorithm for deriving such a system when these conditions are satisfied.

In addition, the significance of the periodic system thus obtained for describing the original periodic process that is largely system equivalent to the system, is clarified by showing that the controllability, the reconstructibility, the stabilizability, the detectability, the stacked transfer matrix, the asymptotic stability, the rate of convergence of the free motions, and even the number and the dimensions of the Jordan blocks of the monodromy matrix corresponding to each nonnull characteristic multiplier of the periodic system, are determined by the original periodic process (although the order of the periodic system is not, in general, as well as its reachability and observability properties, because of some possible additional or removed null characteristic multipliers).

Keywords:

AMS Subject Classification: 93B;