On Model Reduction for Periodic Descriptor Systems Using Balanced Truncation

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Abstract

Linear periodic descriptor systems represent a broad class of time evolutionary processes in micro-electronics and circuit simulation in particular. In this paper we consider discrete-time linear periodic descriptor systems and study the concepts of periodic reachability and observability of the systems based on earlier ideas of Chu et al. [1]. We define reachability and observability Gramians with respect to the whole period and show that they satisfy some projected generalized discrete-time periodic Lyapunov equations. We also study the concept of "lifted" representations of the original periodic system. For standard state-space systems, this is used to define Gramians via discrete-time Lyapunov equations, e.g., by Varga [2] (for algorithms, see also [3]) and for the analysis of periodic descriptor systems in [4]. Combining both concepts, we can also derive a definition of Gramians for periodic discrete-time descriptor systems. We discuss both approaches and propose model reduction methods based on balanced truncation, the Gramian definitions discussed before, and the resulting concepts of Hankel singular values. We illustrate the behaviour of the suggested model reduction techniques using numerical examples.

References

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