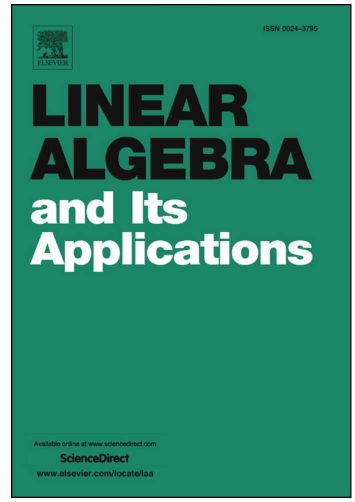

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Data-driven Structured Realization

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Abstract

We present a framework for constructing structured realizations of linear dynamical systems having transfer functions of the form $\widetilde{C}(\sum_{k=1}^{K} h_k(s)\widetilde{A}_k)^{-1}\widetilde{B}$ where h_1, h_2, ..., h_K are prescribed functions that specify the surmised structure of the model. Our construction is data-driven in the sense that an interpolant is derived entirely from measurements of a transfer function. Our approach extends the Loewner realization framework to a more general system structure that includes second-order (and higher) systems as well as systems with internal delays. Numerical examples demonstrate the advantages of this approach.

Keywords: structured realization, data-driven model reduction, interpolation, delay system, second-order system, moment matching

1. Introduction

The simulation of complex physical, chemical, or biological processes is a standard task in science, engineering, and industry. The dynamics of such processes are commonly modeled as dynamical systems, which then can be analyzed (often through simulation) for optimization and control. The demand for higher fidelity models produces as a common consequence ever more complex and larger dynamical systems, whose simulation may require computational resources that become unmanageably large. This computational cost is often directly related to the state space dimension of the underlying dynamical system, thus creating a need for low-dimensional approximations of large-scale models. Model order reduction (MOR) techniques using rational interpolation methods

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