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FÜR DYNAMIK KOMPLEXER
TECHNISCHER SYSTEME
MAGDEBURG

CSC Seminar

SPEAKER

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TITLE

The Loewner framework for parametric systems: Taming the curse of dimensionality

ABSTRACT

The Loewner framework is an interpolatory framework for the approximation of linear and nonlinear systems. The purpose here is to extend this framework to linear parametric systems with an arbitrary number n of parameters. One main innovation established here is the construction of data-based realizations for any number of parameters. Equally importantly, we show how to alleviate the computational burden, by avoiding the explicit construction of large-scale n-dimensional Loewner matrices of size N x N. This reduces the complexity from O(N^3) to about O(N^1.4), thus taming the curse of dimensionality and making the solution scalable to very large data sets. To achieve this, a new generalized multivariate rational function realization is defined. Then, we introduce the n-dimensional multivariate Loewner matrices and show that they can be computed by solving a coupled set of Sylvester equations. The null space of these Loewner matrices then allows the construction of the multivariate barycentric transfer function. The principal result of this work is to show how the null space of the n-dimensional Loewner matrix can be computed using a sequence of 1-dimensional Loewner matrices, leading to a drastic computational burden reduction. Finally, we suggest two algorithms (one direct and one iterative) to construct, directly from data, multivariate (or parametric) realizations ensuring (approximate) interpolation. Numerical examples highlight the effectiveness and scalability of the method. More details can be found in the recent preprint [1].

[1] A. C. Antoulas, I. V. Gosea, and C. Poussot-Vassal, The Loewner framework for parametric systems: Taming the curse of dimensionality, arXiv:2405.00495 [math.NA], available online at https://arxiv.org/abs/2405.00495, submitted to the SIAM Review Journal, April 2023.

Tuesday, June 11, 2024 at 2 pm
seminar room Prigogine