RATIONAL APPROXIMATION FOR DATA-DRIVEN MODELING AND COMPLEXITY REDUCTION OF LINEAR AND NONLINEAR DYNAMICAL SYSTEMS (MS - ID 69)

Algorithms for identification and reduction of nonlinear dynamical systems from time-domain data

Dimitrios S. Karachalios

Max-Planck Institute - Magdeburg

karachalios@mpi-magdeburg.mpg.de

Ion Victor Gosea

Max-Planck Institute - Magdeburg

gosea@mpi-magdeburg.mpg.de

Athanasios C. Antoulas

Rice University-Houston, Max-Planck Institute - Magdeburg, Baylor College of Medicine - Houston

aca@rice.edu

We propose a comparison of algorithms that use time-domain data to fit models of dynamical systems that explain the available measurements. The eigensystem realization algorithm (ERA) and the Loewner framework (LF) constitute data-driven methods for identifying and reducing linear and nonlinear dynamical systems. The ERA uses the system's invariants known as Markov parameters into a matrix of Hankel structure. Similarly, the LF encodes the invariants of a system into the Loewner matrix structure through frequency-domain measurements. These can be estimated from time-domain data by employing spectral transforms. For both methods under consideration, the singular value decomposition (SVD) provides a trade-off between the complexity and the accuracy of the reduced model. These two approaches are compared first for the case of fitting linear systems and then, for fitting systems with nonlinear dynamics, such as bilinear systems. We discuss recent extensions for the latter case.