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

Numerical aspects of the Koopman and the dynamic mode decomposition for model reduction

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The Dynamic Mode Decomposition (DMD) is a tool of trade in computational data driven analysis of complex dynamical systems, e.g. fluid flows, where it can be used to decompose the flow field into component fluid structures, called DMD modes, that describe the evolution of the flow. The DMD is deeply connected with the analysis of nonlinear dynamical systems in terms of the spectral data of the associated Koopman operator. The main tasks of the analysis are approximations of eigenfunctions and eigenvalues of the operator, and computation of a spatio-temporal representation of the data snapshots, based on the computed eigenvalues and eigenfunctions. The latter includes possibly ill-conditioned least squares problem.

Exceptional performances motivated developments of several modifications that make the DMD an attractive method for identification, analysis and model reduction of nonlinear systems in data driven settings.

In this talk, we will present our recent results on the numerical aspects of the DMD/Koopman analysis. We show how the state of the art numerical linear algebra can be deployed to improve the numerical performances in cases that are usually considered notoriously ill-conditioned. The numerical framework is based on algorithms that also apply e.g. to matrix rational approximations in modeling by Vector Fitting.