MoRePaS 2015

# Structure-preserving Model Reduction

C. Beattie[1]

[1]Department of Mathematics, Virginia Tech, Blacksburg, VA, US

Dynamical systems form the basic modeling framework for an enormous variety of complex systems. Direct numerical simulation of the correspondingly complex dynamical systems is one of few means available for accurate prediction of the associated physical phenomena. However, the ever increasing need for improved accuracy requires the inclusion of ever more detail in the modeling stage, leading inevitably to ever larger-scale, ever more complex dynamical systems that must be simulated.

Simulations in such large-scale settings can be overwhelming and make unmanageably large demands on computational resources; this is the main motivation for model reduction, which has as its goal production of much simpler dynamical systems retaining the same essential features of the original systems (high fidelity emulation of input/output response and conserved quantities, preservation of passivity, etc.).

I will describe briefly the objectives and methodology of systems-theoretic approaches to model reduction, focussing for the most part on interpolatory projection methods that are both simple and capable of providing nearly optimal reduced order models in many circumstances. Interpolatory methods provide a framework for model reduction that allows for the retention of special structure such as parametric dependence, port-Hamiltonian structure, and internal delays. Nonintrusive “data-driven” approaches will be discussed as well.