Mini-symposium Proposal for the *15th ILAS Conference* Cancún, México, June 16–20, 2008: *Linear Algebra in Model Reduction*

Peter Benner
Chemnitz University of Technology
Fakultät für Mathematik
09107 Chemnitz
Germany
benner@mathematik.tu-chemnitz.de

November 13, 2007

Model reduction is an ubiquitous tool in analysis and simulation of dynamical systems, control design, circuit simulation, micro-systems technology, structural dynamics, CFD, etc. In the past decades many approaches have been developed for reducing the order of a given model. Often these methods have been derived in parallel in different disciplines with particular applications in mind. Common ground to all these methods is applied and numerical linear algebra as well as matrix theory. Very roughly speaking, the two most successful classes of methods are

1. Krylov-subspace methods related to Padé approximation and (rational) interpolation,
2. singular value decomposition (SVD) related methods, including system-theoretic and balancing-related techniques.

All of these methods have progressed during the past 15 years mostly due to the use of new and efficient techniques from numerical linear algebra, but also due to deeper insight into matrix analysis (one example being the use of indefinite bilinear forms in various approaches). These developments have considerably widened the range of applicability of some of the methods, e.g., balanced truncation can nowadays be applied to state-space dimensions up to order 10^6.

The mini-symposium will highlight several recent developments in this context. In particular, some talks will address the increasingly more important insight gained from viewing Krylov-subspace based model reduction methods as rational interpolation methods. Here, some old ideas from approximation theory and newer ones from the theory of rational matrix functions lend themselves to new algorithmic developments when combined with Krylov subspace methods. Another important issue is the presence of parameters in the system. These may represent varying geometries, material properties, boundary conditions (of the underlying discretized partial differential equation), etc. For engineers and designers, it is often important to preserve these as free parameters in the reduced-order model in order to do fast simulations for changing parameter configurations or to use them as decision variables in optimization processes. Two talks will address this new challenge. The remaining talks center around the second class of model reduction methods and mainly focus on several new ideas to widen the applicability of balancing-related model reduction methods to areas they were not believed to be applicable to just a few years ago.

The following confirmed talks are planned within this mini-symposium:

1. **Serkan Gugercin** (Virginia Tech, Blacksburg, USA; gugercin@math.vt.edu):

   A Krylov-Based Descent Approach for the Optimal H_2 Model Reduction of Large-Scale Dynamical Systems

2. **Paul Van Dooren** (Université Catholique Louvain-La-Neuve, Belgium; paul.vandooren@uclouvain.be):

   H_2 Approximation and Tangential Rational Interpolation

3. **Christopher Beattie** (Virginia Tech, Blacksburg, USA; beattie@vt.edu):

   Interpolatory Projection Methods for Parameterized Model Reduction

4. **Lihong Feng** (Chemnitz University of Technology, Germany/Fudan University Shanghai, China; lhfeng@fudan.edu.cn):

   Parametric Model Reduction for Systems with Coupled Parameters

5. **Roland Freund** (University of California, Davis, USA; freund@math.ucdavis.edu):

   The Effects of Deflation in Projection-Based Order Reduction

6. **Ulrike Baur** (Chemnitz University of Technology, Germany; baur@mathematik.tu-chemnitz.de):

   Model Reduction for unstable Systems based on Hierarchical Matrix Arithmetic

7. **Tobias Damm** (TU Kaiserslautern, Germany; damm@mathematik.uni-kl.de):

   Algebraic Gramians and Model Reduction for Different System Classes

8. **Peter Benner** (Chemnitz University of Technology, Germany; benner@mathematik.tu-chemnitz.de):

   Balancing-Related Model Reduction for Large-Scale Unstable Systems

The estimated number of participants in this mini-symposium is 25–30.