The need for novel model order reduction techniques in the electronics industry

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Both in systems and control engineering and in numerical analysis, a wealth of model order reduction techniques have been developed. Balanced truncation, Krylov subspace methods, proper orthogonal decomposition and other SVD-based methods are just a few classes of methods that have been developed. The electronics industry has been one of the main providers of motivating examples, and indeed model order reduction has found widespread use in this industry.

In the past decade, the electronics industry has continued to formulate challenging research topics in the field of model order reduction. This has led to the search for provably passive Krylov subspace methods such as PRIMA and Laguerre-type methods. Of equal importance are the structure-preserving methods, of which SPRIM and structure-preserving PMTBR are examples.

Unfortunately, despite all efforts, many unsolved problems remain, and the industry is anxiously waiting for solutions. In this talk, the demands of the electronics industry with respect to model order reduction will be detailed. It will be shown that structure preservation is still not in a state that is acceptable to the business, and that different concepts and methods are needed. Related to this is the problem of realization, meaning that the mathematically reduced order model should be cast into a physically realizable model mimicking properties of the original model. Another important problem is that of the reduction of networks with many inputs and outputs. Krylov methods cannot handle such problems, and methods that make use of singular value decompositions are not applicable in most cases. Finally, the state of nonlinear and parameterized model order reduction techniques is far from mature enough to help the industry cope with their problems in behavioural and/or response surface modeling.

Several examples will be given in the talk, and the recently published book [1] contains also a number of applications and research questions for model order reduction in the electronics industry.

[1] W.H.A. Schilders, H.A. van der Vorst and J. Rommes, "Model Order Reduction: Theory, Research Aspects and Applications", ECMI Series on Mathematics in Industry, vol. 13, Springer-Verlag, Berlin-Heidelberg (2008)