



CSC Seminar

SPEAKER

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TITLE

Data-driven macromodeling with stability and passivity constraints

ABSTRACT

This talk will present a general framework for the construction of uniformly stable and passive reduced-order models of parameterized LTI systems, with emphasis on electrical, electronic and electromagnetic applications. The approach is data-driven: macromodels are generated from a set of frequency-domain responses available from first-principle (circuit or electromagnetic) solvers through an iterative process based on a generalised Sanathanan-Koerner iteration [1]. The framework can be interpreted as a multivariate generalisation of rational approximation schemes such as Vector Fitting and Loewner methods. The main difficulty that is addressed in this research activity is the formulation of a model structure and related algebraic constraints that are able to guarantee model stability and passivity for any combination of the parameters upon which the structure behavior depends. We will review various strategies to characterise and enforce stability (passivity), including multivariate Hamiltonian-matrices [2] and parameterized KYP approaches [3,4,5]. The effectiveness of this framework will be demonstrated both for passive structures (e.g. integrated inductors) and for linearised active analog electronic circuit blocks (e.g. low drop-out voltage regulators). For the latter class, a further extension will be presented, enabling fast transient analysis under non-stationary operating/biasing conditions, for which up to 3 orders of magnitude speedup in runtime was demonstrated with respect to high-fidelity models.

REFERENCES

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- [2] A. Zanco, S. Grivet-Talocia, "On checking dissipativity of parameterized linear and time-invariant circuits and systems", *Int. J. Circuit Theory and Applications*, to appear.
- [3] T. Bradde, S. Grivet-Talocia, A. Zanco, and G. C. Calafiore, Data-driven extraction of uniformly stable and passive parameterized macromodels, *IEEE Access*, vol. 10, pp. 15786-15804, 2022.
- [4] T. Bradde, S. Grivet-Talocia, P. Toledo, A. V. Proskurnikov, A. Zanco, G. C. Calafiore, and P. Crovetto, Fast simulation of analog circuit blocks under nonstationary operating conditions, *IEEE Trans. on Components, Packaging and Manufacturing Technology*, vol. 11, pp. 1355-1368, Sept. 2021.
- [5] A. Zanco, S. Grivet-Talocia, T. Bradde, and M. De Stefano, Uniformly stable parameterized macromodeling through positive definite basis functions, *IEEE Trans. on Components, Packaging and Manufacturing Technology*, vol. 10, pp. 1782-1794, Nov 2020.

Tuesday, January 30, 2023 at 11 am
seminar room Prigogine