Algorithms for the extraction of guaranteed stable and passive high-dimensional parameterized macromodels

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Research context and motivation

- In the last few years, the use of numerical simulations in electronics has become a common practice in most of the design workflows, mainly in parameter optimization and design-centering phases. However, as the design complexity increases, the required computational effort become intractable, preventing the use of these techniques for large scale problems.

- Macromodels are compact black-box surrogates that retain only the dominant dynamics of the phenomena under investigation. Thus, when used in place of first-principle simulators (e.g., FEM, Transistor Level SPICE), such models drastically reduce CPU and memory workload.

- We focus on parameterized (linear) - macromodels, that embed in closed form the dependence on several (10^4) design parameters of interest (\( \vartheta \)).

- Parametric macromodeling techniques exist, but they are restricted to a limited number of parameters.

Addressed research questions/problems

- Find appropriate macromodel structure: as the number of external parameters increase, the model complexity must be kept as small as possible.

- Parametric macromodel synthesis: develop efficient model identification algorithms, guaranteed to be uniformly (i.e. for any parameter combination) stable.

- Guaranteeing uniform passivity: if the structure under modeling is passive (i.e. unable to generate energy), the associated macromodel must be passive. If required, passivity must be checked and enforced to guarantee reliable time-domain simulations under any loading condition.

List of attended classes

- 01QTEIU – Data mining concepts and algorithms (14/12/2018, 4 credits)
- 01RC0RT – Scomposizione di tensori: algebra, geometria e matematica computazionale (19/9/2019, 4 credits)
- 01TC0RV – Surrogate and compact modeling: theory for the user (12/7/2019, 4 credits)
- 03SGVVR – Entrepreneurship and start-up creation from University Research (9/5/2019, 8 credits)

List of submitted works

5. BEST STUDENT PAPER AWARD