SIMULATION OPTIMIZATION SYSTEMS LABORATORY: CURRENT RESEARCH

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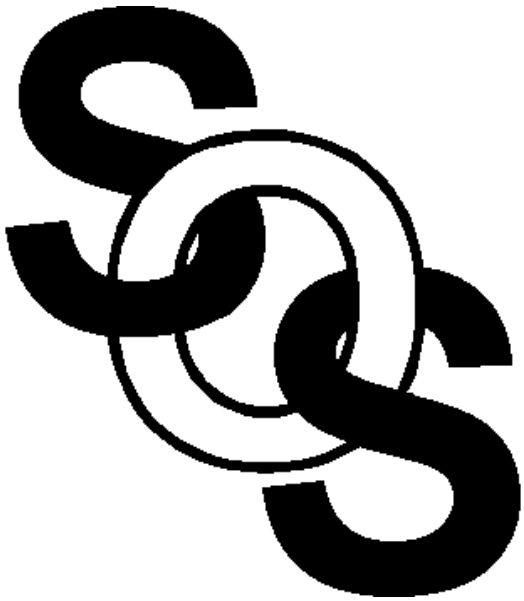

Simulation Optimization Systems (SOS)
Research Laboratory

CAD/CAE of electronic devices and circuits

applications in high speed, RF, wireless and microwaves

modeling and design of active and passive components and circuits

exploitation of the Space Mapping (SM) concept

SM links models of different complexities, e.g., full-wave EM simulations and empirical circuit-theory based simulations

SM accelerates iterative design optimization of engineering structures, e.g., waveguide components and microstrip circuits

the Aggressive Space Mapping approach to engineering design optimization

Artificial Neural Network technology for device modeling and circuit optimization

Neuro Space Mapping (NSM) for device modeling

Funding

Natural Sciences and Engineering Research Council of Canada (NSERC)

Micronet Network of Centres of Excellence

TRIO, Com Dev Ltd., Nanowave Technologies Inc.

Major Project

NSERC Strategic Grant:

Next Generation Optimization Methodologies for Wireless and Microwave Circuit Design

J.W. Bandler (McMaster University)
and Q.J. Zhang (Carleton University)
Principal Investigators

Short Term Goal

To significantly advance the state-of-the art in automated EM design, through fully integrated tools, new design methodologies and corresponding algorithms

A Generalized Space Mapping Tableau Approach to Device Modeling

Generalized Space Mapping (GSM)

GSM is a comprehensive framework for engineering device modeling

GSM permits many different practical implementations

available empirical models of microwave devices can be significantly enhanced by modest EM simulation effort

some fundamental special cases:

basic Space Mapping Super Model (SMSM)
Frequency-Space Mapping Super Model (FSMSM)

SMSM maps designable device parameters

FSMSM also maps the frequency variable

SMSM and FSMSM concepts verified on microstrip modeling problems, typically utilizing a few full-wave EM simulations

significant improvement of model accuracy within parameter regions of interest

Neuromodeling of Microwave Circuits Exploiting Space Mapping Technology

Neuro Space Mapping (NSM)

NSM: neuromodeling of microwave circuits based on Space Mapping (SM) technology and Artificial Neural Networks (ANN)

exploits the advantages of both SM and ANN

SM based neuromodels decrease the cost of training, improve generalization ability and reduce complexity of the ANN topology w.r.t. classical neuromodeling

novel techniques to generate SM based neuromodels:

- Space-Mapped Neuromodeling (SMN)
- Frequency-Dependent Space-Mapped Neuromodeling (FDSMN)
- Frequency Space-Mapped Neuromodeling (FSMN)

Huber optimization trains the NSM

SMN, FDSMN and FSMN concepts verified by microstrip modeling problems, utilizing a few full-wave EM simulations

A Hybrid Aggressive Space Mapping Algorithm for EM Optimization

Hybrid Aggressive Space Mapping (HASM) optimization algorithm

HASM exploits both the Trust Region Aggressive Space Mapping (TRASM) algorithm and direct optimization

does not assume that the final space-mapped design is the true optimal design

robust against severe misalignment between the coarse and the fine models

based on a novel lemma that enables smooth switching from the TRASM optimization to direct optimization and vice versa

tested on microwave filters and impedance transformers

An Aggressive Approach to Parameter Extraction

Aggressive Parameter Extraction (APE) algorithm

APE uses optimal selection of perturbations to increase trust in parameter extraction uniqueness

criterion for the generation of these perturbations is established

approaches for two possible classifications of candidate extracted parameters

a robust algorithm integrates these two approaches

the algorithm terminates if the extracted parameters can be trusted

tested on microwave impedance transformer and filters

Modeling of Microwave Circuits Exploiting Space Derivative Mapping

fast and accurate models for design-oriented simulation of microwave circuits over wide parameter ranges are crucial

Space Derivative Mapping (SDM) exploits the existence of "coarse" and "fine" circuit models

based on Space Mapping (SM)

constructs a locally valid circuit model exploiting available empirical simulations and response sensitivity information

the SDM model enjoys higher accuracy than that of direct linear response interpolation

based on a lemma that estimates the mapping between the two spaces using one single parameter extraction

uniqueness of the extracted parameters is not an issue

statistical analysis of waveguide impedance transformers and filters demonstrates this technique