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Takeaways from the first Workshop on Modeling and Optimization for Active Devices

Authors: Justin King (Trinity College Dublin, Ireland) and Gian Piero Gibiino (University of Bologna, Italy)

Introduction

The first IEEE Young Professional Workshop on *Modeling and Optimization for Active Devices* took place on October 25, 2022, as a virtual event on Zoom. This workshop, supported by the Technical Committee 2 (TC-2) on Design Automation, was endorsed by the IEEE MTT-S and the IEEE Young Professionals (YP). Trinity College Dublin, Ireland and the University of Bologna, Italy provided organizational support.



Fig. 1: Workshop Advertisement Banner.

Event Overview

The event was primarily targeted at young professionals and PhD/early-career stage researchers from academia or industry. The aim of the workshop was to provide a platform for the discussion of recent and prospective trends in the field of RF active device modeling and related optimization techniques. These research themes are identified by TC-2 as key to this field, as recently outlined in [1]. The workshop was promoted through social media channels (see Fig. 1 for the advertisement banner used). To gain access to the workshop, online registration was required, with participation free of charge.

The workshop was divided into two live presentation sessions, one in the morning (10:00-12:00 UTC) and one in the afternoon (14:00-16:00 UTC). Each session consisted of four presentations, delivered by invited YP speakers, with a duration of 25 minutes per presentation including Q&A immediately following each presentation.

The YP speakers were invited based on their research activity on relevant topics (as outlined in the references provided below). The morning session focused primarily on transistor-level modeling, with the initial presentations by Ph.D. student P. Beleniotis (Brandenburg University of Technology, Germany) and Dr. Nunes (University of Aveiro, Portugal) focusing on modelling of trapping effects in GaN HEMTs [2], [3]. The final two presentations by Dr. S. Yadav (imec, Belgium) and Dr. N. Miller (Air Force Research Laboratory, USA) were dedicated to process technology developments and TCAD-based modeling techniques [4], [5].

The afternoon session focused on system-level nonlinear modeling techniques, specifically targeting power amplifiers. The first presentation, given by master's student Xiaoqiang Tang (Hangzhou Dianzi University, China), provided an overview of behavioral modeling approaches, and the second presentation by Dr. L. Kouhalvandi (Dogus University, Turkey) addressed model-based optimization

methods for PA design [6]. The final two presentations, given by PhD students M. Mengozzi (University of Bologna, Italy) and W. Li (Universitat Politècnica de Catalunya, Spain), covered digital predistortion and optimization-based techniques tailored to multiple-input PAs [7], [8].

In between the presentation sessions were two live and interactive panel sessions, with the panel formed from seven experts from the MTT community – see Inset 1.

Expert Panelists

- Prof. J. Bandler (McMaster University, Canada)
- Prof. P. L. Gilabert (Universitat Politècnica de Catalunya, Spain)
- Prof. S. Khandelwal (Macquarie University, Australia)
- Prof. J. C. Pedro (University of Aveiro, Portugal)
- Prof. M. Pirola (Politecnico di Torino, Italy)
- Prof. M. Rudolph (Brandenburg University of Technology, Germany)
- Prof. Q. J. Zhang (Carleton University, Canada)

Inset 1: List of expert panelists.

The first of these sessions involved a round-table discussion with three topical questions put to the panel as shown in Inset 2.

Questions for Round-Table Technical Discussion

- Q1: There is a general interest in artificial intelligence (AI) and machine learning (ML) techniques, how impactful has AI/ML been for device modelling/optimisation so far, and how do you expect it to contribute to its future?
- Q2: There has been a huge focus on Gallium Nitride (GaN) in recent years. What new device technologies are coming down the line and what are the associated modelling challenges?
- Q3: Given the advances in numerical algorithms and CPU hardware, should we now be considering more advanced, e.g., TCAD oriented models, to be somehow included in the circuit design phase? Or is still the behavioral/analytical device modeling approach the most straightforward option ensuring the trade-off between accuracy and ease-of use?

Inset 2: Questions for Round-Table Technical Discussion.

This session generated several interesting discussions, with a consensus that many developments are to come in modelling, optimisation and active devices, although it is too early to be certain on future dominant device technologies. The panel was excited about the developments in AI/ML, although a word of caution was provided on applying machine learning techniques to situations where alternative, robust and reliable models already exist that can provide useful insight that many AI/ML-based models cannot.

The second panel session took the form of a career advice platform for Young Professionals. The following questions were posed to the panel (see Inset 3).

Questions for Career Advice Panel

- Q1: Imagine you have just obtained your PhD and now seek a post-doc and tenure at an academic institution. What were the most beneficial steps you took during your early-stage career in academia?
- Q2: Research can be exciting but can also be somewhat isolating, especially in the early stages. What would you suggest as the most effective way for collaboration with academia/industry?

Inset 3: Questions for the Career Advice Panel.

The main advice from the panel to YPs was get involved in the MTT community! This could take the form of attending conferences regularly as well as seeking collaboration. One specific piece of advice focused on finding your own path through the research landscape and to not be too concerned with following the latest trends!

Demographics

In total, there were more than 200 registrants with a peak of approximately 70 simultaneous active participants throughout the course of the workshop. A snapshot of attendees is provided in Fig. 2. Despite the different time zones, a Zoom-based poll showed that the meeting consisted of participants from all over the world including, in decreasing number, Europe, USA/Canada and Asia. Most attendees responding to the poll were at the Master's/PhD stage of their careers (48%), followed by University Professor (28%), Professionals in Industry (17%) and finally Research Assistant (7%).



Fig. 2: Attendees of the Workshop on Modeling and Optimization for Active Devices.

Interactivity

Following each contribution, the polling features of Zoom were used to gather audience feedback on the presentation. The workshop participants were asked to place their vote for each presentation on a scale of 0 – 5 across the following criteria:

- 1) Clarity/Quality,
- 2) Technical Content, and
- 3) Originality.

Overall, an average of approximately 23 valid votes were received for each presentation. The winning presentation was by Dr N. Miller, entitled 'Nonlinear RF modelling of GaN HEMTs with Fermi kinetics transport and the ASM-HEMT compact model', as shown in Fig. 3.




Fig. 3: Best Presentation Award.

Summary

As organizers of the inaugural YP Workshop on Modeling and Optimization for Active Devices, we are pleased to report that the event was a success. There was a clear interest among young professionals for online workshops that provide opportunities for informal discussions and feedback on their work, as reflected in the positive feedback received from both participants and panelists. Considering this, we are hopeful for a second edition of the workshop and are open to suggestions, topics of interest, and proposals for presentations or participation. We encourage all young professionals and researchers to engage with us by reaching out to our contacts provided below. We would like to extend our appreciation to the TC-2 Design Automation Committee and the seven panelists for their time and expertise.

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