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Optimizing the Design of Analog Circuits *with Natural and Artificial Intelligence*

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Abstract

The design of analog circuits typically follows the well-established top-down/bottom-up methodology, involving synthesis tasks at various abstraction levels: from specifications/system-level to electrical/circuit-level and finally physical/layout implementation. While significant progress has been made in optimizing the analog synthesis and verification processes, current EDA tools and design methods still fall short of offering a fully automated design flow, unlike the more advanced automation available for digital circuit design.

This talk provides an historical perspective and overview of the automated design and optimization of analog and mixed-signal circuits and systems, and how the different optimization techniques, heuristic methods and expert human know-how are combined with emerging Machine Learning (ML) based approaches. Sigma-Delta ($\Sigma\Delta$) Modulators will be taken as examples and case studies to illustrate the evolution *with natural and artificial intelligence* in design automation of analog circuits and systems.

José M. de la Rosa (Fellow, IEEE) received the M.S. degree in Physics in 1993 and the Ph.D. degree in Microelectronics in 2000, both from the University of Seville, Spain. Since 1993 he has been working at the Institute of Microelectronics of Seville (IMSE), which is its turn part of the Spanish Microelectronics Center (CNM) of the Spanish Council of Scientific Research (CSIC). He does his research at IMSE, where he served as vice-director from February 2018 to March 2023, and he is also a Full Professor at the Dept. of Electronics and Electromagnetism of the University of Seville. Since April 2023, he is the Director of the International Projects Office of the University of Seville. His main research interests are in the field of analog and mixed-signal integrated circuits, especially high-performance (sigma-delta) data converters, including analysis, behavioral modeling, design and design automation of such circuits. In these topics, Dr. de la Rosa has participated in a number of Spanish and European research and industrial projects, and has co-authored nearly 300 international publications, including journal and conference papers, 11 book chapters and 6 books. He is in the World's Top 2% Scientists List from Stanford University (editions 2019-2024).

Dr. de la Rosa is an IEEE Fellow and member of the IEEE Circuits and Systems Society (CASS) and the IEEE Solid-State Circuits Society (SSCS). He served as a Distinguished Lecturer of IEEE-CASS (term 2017-2018), and as Chair of the Spain Chapter of IEEE-CASS during the term 2016-2017. He was at the front of the Editorial Board of IEEE Transactions on Circuits and Systems II: Express Briefs, where he served as Deputy Editor-in-Chief since 2016 to 2019, and as Editor-in-Chief (EiC) in the term 2020-2021. He is a member of the TechRxiv Editorial Advisory Board since 2022. He also served as Associate Editor for IEEE Transactions on Circuits and Systems I: Regular Papers, where he received the 2012-2013 Best Associate Editor Award and was Guest Editor for the Special Issue on the Custom Integrated Circuits Conference (CICC) in 2013 and 2014. He served as Guest Editor of the Special Issue of the IEEE J. on Emerging and Selected Topics in Circuits and Systems on Next-Generation Delta-Sigma Converters. He is a member of the Analog Signal Processing Technical Committee of IEEE-CASS and of the Steering Committee of IEEE MWSCAS. He has also been involved in the organizing and technical committees of diverse international conferences, among others IEEE ISCAS, IEEE MWSCAS, IEEE ICECS, IEEE LASCAS, IFIP/IEEE VLSI-SoC, DATE and ESSCIRC. He served as TPC chair of IEEE MWSCAS 2012, IEEE ICECS 2012, IEEE LASCAS 2015 and IEEE ISICAS (2018, 2019). He has been a member of the Executive Committee of the IEEE Spain Section (terms 2014-2015 and 2016-2017), where he served as Membership Development Officer during the term 2016-2017. He is Member-at-Large of the IEEE-CASS Board of Governors (BoG) for the 2023-2025 term and serves as Editor-in-Chief for the *IEEE Transactions on Circuits and Systems – I: Regular Papers in 2024-2025*.
Contact data and more details about the speaker available at www.imse-cnm.csic.es/~jrosa.