Guest Editorial: Analog, Mixed-Signal and RF Testing

Manuel J. Barragan¹ · William R. Eisenstadt²

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The role of nano-electronic systems is rapidly expanding in every facet of modern life. To interact with environment and users, integrated circuits need analog, mixed-signal, RF or MEMS blocks. These blocks could represent a small part of the chip area but have a major impact on IC yield and reliability. Indeed, one of the major bottlenecks nowadays for nano-electronics systems is the post-manufacturing testing of their analog, mixed-signal, RF, and MEMS functions, in order to guarantee outgoing quality while not sacrificing yield. Testing such functions is becoming a dominant contributor to the overall manufacturing cost of an integrated system. Moreover, in addition to the post-manufacturing testing problem, modern safety-critical, mission-critical, and remote-controlled systems need to be equipped with self-test, concurrent error detection, and fault-tolerance capabilities so as to detect early reliability hazards and guarantee reliable operation even in harsh environments. For such systems, diagnosing the sources of failures occurring in the field of operation is of vital importance, in order to

apply corrective actions and to prevent failure reoccurrence. In this scenario, there is still a lot of room for innovation to improve AMS-RF testing.

This special issue of JETTA brings together 8 excellent papers from academia and industry. Most of these papers are expanded versions of the preliminary work presented at the 21st International Mixed-Signal Testing Workshop (IMSTW), held in Sant Feliu de Guíxols, Spain, 4-6 July, 2016. As Program Chairs of IMSTW, in addition to inviting submissions for this JETTA special issue, we also decided to open the call-for-papers to new contributions beyond the workshop community.

The first three papers deal with advanced spectral manipulation techniques to improve the quality and efficiency of analog test stimulus in a production test environment. Thus, the paper by Sarson analyzes the use of a chirped test stimulus for RF filter characterization. The proposed approach demonstrates significant advantages in test time efficiency compared to a traditional test setup. The second paper, contributed by Sarson and Kobayashi, employs a distortion shaping strategy to improve and equalize ATE performance in THD ADC testing on a test production floor. The third paper, contributed by Zhuang and Chen, offers an optimized algorithm for ADC spectral testing applications in the presence of a number of non-idealities that are common in production test environments, such as non-coherent sampling and signal amplitude drift.

The fourth paper, by Gómez-Pau, Balado and Figueras, proposes a simple methodology for improving the accuracy of machine learning classifier models in a mixed-signal

✉ Manuel J. Barragan
Manuel.Barragan@univ-grenoble-alpes.fr

William R. Eisenstadt
wre@tec.ufl.edu

¹ Université Grenoble-Alpes, CNRS, TIMA, Grenoble, France

² Electrical and Computer Engineering Department, University of Florida, Gainesville, FL 32611 USA

test scenario. The proposed strategy is based on a geometrical transformation of the space of input measurements and demonstrates an ability to reduce false positive test outcomes by a factor of 50.

The next two papers focus on fault detection and diagnosis. Thus, the fifth paper, contributed by Dhend and Chile, proposes a novel fault diagnosis algorithm in the context of smart grid power distribution systems, based on a combination of smart sensors and wavelet function analysis. Results show an improvement in the accuracy of fault location compared to the previous art. The sixth paper, contributed by Luo, Lu, Y. Wang and L. Wang, explores the problem of efficient test point selection for fault detection and diagnosis in analog circuits.

Finally, the last two papers in this special issue, invited from IMSTW contributions, try to reach beyond classical test issues and open new research opportunities for the mixed-signal test community. Thus, the seventh paper, by Patel, Jiang and Kaminska, presents an innovative optical authentication and security system based on a pattern of nano-structures that can be used for device authentication without altering the electrical behavior of the device circuitry. The eighth paper, by Deluthault, Kerzérho, Bernard, Soulier and Cauvet, goes into the domain of biosensors for medical applications and proposes an efficient calibration technique for a contact-less Intra-Ocular Pressure sensor that is targeted at the detection of the glaucoma disease.

We would like to thank all authors and reviewers for their contributions to this special issue. Without their work and support, this issue would not have been possible. Special thanks are due to Prof. Vishwani Agrawal, Editor-in-Chief, for his invaluable help and guidance. We hope you enjoy reading this special issue and find it interesting and useful.

Manuel J. Barragan received a MSc degree in physics in 2003 and a PhD degree in Microelectronics in 2009, both from the University of Seville, Spain. He is currently a Researcher with the French National Research Council (CNRS) at TIMA Laboratory, France. His research is focused on the topics of test and design for testability of analog, mixed-signal, and RF systems. He served as the General Chair of the 2014 Statistical Test Methods Workshop, as the Program Chair of the 2015 IEEE International Workshop on Test and Validation of High Speed Analog Circuits, as the Program Chair of the 2016 IEEE International Mixed-Signal Testing Workshop, and as Track Chair of the Test and Reliability track of the 2014 IEEE International Conference on Electronics Circuits and Systems. He currently serves in the Technical Program Committee of the Design, Automation, and Test in Europe (DATE) Conference and as a Review Editor for Wiley International Journal of Circuit Theory and Applications. His Ph.D. research won a Silver Leaf Award at the IEEE PRIME conference in 2009 and in 2011 his work was selected for inclusion in the 20th Anniversary Compendium of Most Influential Papers from the IEEE Asian Test Symposium. He received the Best Special Session Award in the 2015 IEEE VLSI Test Symposium.

William R. Eisenstadt received BS, MS and PhD degrees from Stanford University in 1979, 1981 and 1986, respectively, and is currently a professor at the University of Florida. Dr. Eisenstadt leads efforts in developing new mixed-signal IC test techniques and courseware. He was Program Co-chair for the Wireless Test Workshop (2003 to 2010), has been a member of the ISCAS Conference, Analog Signal Processing Technical Committee, ASTPC, 2003-2015 and Program Co-Chair of the 2016 IEEE International Mixed-Signal Testing Workshop. He recently has developed a unique two semester graduate level mixed signal IC test course sequence on the NI STS IC tester, using Labview and TestStand software. In addition, he works on wireless sensor platforms for human health and safety applications. Dr. Eisenstadt combines electronic design, packaging, and embedded software design for wireless sensor systems in collaboration with leading researchers in entomology (mosquitos, flies, etc.), power systems, and biomedicine. Dr. Eisenstadt has over 35 years of experience in analog, digital and microwave test and circuit design. Eisenstadt has published over 160 refereed conference and journal publications, is the inventor of 13 patents and has advised 24 PhD graduates.