Proceedings of the

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DCAS 2020

November 15-16, 2020

The University of Texas at Dallas, Richardson, Texas USA

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2020 IEEE 14th Dallas Circuits and Systems Conference

November 15th – 16th, 2020

This Year conference was running virtual

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FOREWORD

We are pleased to present the Proceedings of the 2020 14th IEEE Dallas Circuits and Systems Conference, organized by the Dallas Chapter of the Circuits and Systems Society and 2020 conference committee members introduced in next section.

This year the conference was virtual (online), due the Coronavirus pandemic; we hope and trust that everyone involved thereby avoided illness. It was jointly sponsored by the Dallas Chapters of the IEEE Circuits and Systems Society, the IEEE Solid-State Circuits Society, and the IEEE Electron Devices Society, as well as the University of Texas at Dallas (UTD) and the Dallas Section of the IEEE.

The two-day conference, held on Nov. 15 and 16 in two tracks, featured 31 accepted papers, five keynote presentations and three industrial talks. The conference attracted professionals and researchers not only from local industry and academia but also nationally and internationally.

We were honored to host five highly distinguished keynote speakers: Dr. Bernhard Wicht, Dr. Houman Homayoun, Dr. Roozbeh Jafari, Dr. R. Bogdan Staszewski and Dr. Tinoosh Mohsenin. Their topics, affiliations, abstracts and biographies are in the section on keynote speakers below. We greatly appreciate our patron sponsors and industrial presenters, from Liquid Instruments and Ambiq.

We are very thankful for the excellent services of the organizing committee, and would also like to express our appreciation to the Technical Program Chairpersons and the paper reviewers who helped in the selection of the papers that are being published here, as well in providing helpful comments to the authors, resulting in improved publications and presentations. In addition, we are grateful to the volunteer session chairs and co-chairs who assisted the committee in the successful execution of the conference.

Lastly, we also thank all the authors and attendees for their support of the conference and of the Dallas Circuits and Systems Society. We believe that the keynote talks, industry presentations, and the paper presentations, are informative and beneficial for you all, and we hope to see you again at the next conference.

Tooraj Nikoubin & Terence Blake

General Chairs

2020 IEEE 14th Dallas Circuits and Systems Conference

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- Alec Maxwell Steele, University of Texas at Dallas
- Farzaneh Jalalibidgoli, University of Texas at Dallas

CONFERENCE AGENDA

NOVEMBER 15, 2020

Start time	Session			Presentation/Paper Title		
9:30	**Opening Dr. Lawrence Overzet**					
9:45	**Keynote Speaker # 1** **Session Chair: Hoi Lee** **Co-Chair:Farzaneh Jalali** **(Room # 1)**	**DR. BERNHARD WICHT**		**Tiny and Efficient – Power Management as a Key Function in Microelectronic Systems**		
10:45	**Break**					
11:00	**Session # 1** **Session Chair: Hoi Lee** **Co-Chair: Farzaneh Jalali** **(Room # 1)**	**Paper #**	**1-1** 1.37A,2A Current Regulating High Side Driver With 0.4ÂµJ Energy Limitation During Unpowered State	**Session # 2** **Session Chair: Ava Hedayatipour** **Co-Chair: Alec Steele** **(Room # 2)**	**Paper #**	**2-1** Neural Network-Based Mitigation of Nonlinear In-band Distortion in Coded OFDM System
11:15			**1-2** Advanced Non-linear Control Technique for Current-Fed Full-Bridge DC-DC Converter			**2-2** Clipping Noise Mitigation by Adaptive Nulling and Nondata-Aided Compensation in Coded OFDM
11:30			**1-3** A Novel Modulation Method to Reduce Leakage Current in Transformerless Z-source PV Inverters			**2-3** Data Flow Mapping onto DNN Accelerator Considering Hardware Cost
11:45			**1-4** Ternary Limited-Weight Codes and Quaternary Transition-Signaling for Low-Power Bus Encoding			**2-4** The Characterization and Assembly of an Efficient Cost Effective Focused Ultrasound Transducer
12:00	**Lunch break**					
12:30	**Keynote Speaker # 2** **Session Chair: Ifana Mahbub** **Co-Chair: Farzaneh Jalali** **(Room # 1)**	**DR. HOUMAN HOMAYOUN**		**Towards Hardware Cybersecurity**		

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<table>
<tr><td>13:30</td><td colspan="6">Break</td></tr>
<tr><td>1:45</td><td rowspan="4">Session # 3
Session Chair: Ifana Mahbub
Co-Chair: Farzaneh Jalali
(Room # 1)</td><td rowspan="4">Paper #</td><td>3-1 Formal Verification of Non-Functional Strategies of System-Level Power Management Architecture in Modern Processors</td><td rowspan="4">Session # 4
Session Chair: Ava Hedayatipour
Co-Chair: Alec Steele
(Room # 2)</td><td rowspan="4">Paper #</td><td>4-1 Study the Effects of Misalignments in the Printed Spiral Inductive Coils for the Passive Wearable Sensors</td></tr>
<tr><td>2:00</td><td>3-2 ACPA: Exploiting Approximate Computing for High-Level Imprecision Optimization of Fixed-point LTI systems</td><td>4-2 A Miniaturized High-efficient Headstage Based WPT System for Optogenetic Stimulation of Freely Moving Animal</td></tr>
<tr><td>2:15</td><td>3-3 Custom Real-Time-Kinematics Positioning System Testbed for Mobile Robot Localization</td><td>4-3 Study on impact of process on Bitcell design in FinFets</td></tr>
<tr><td>2:30</td><td>3-4 A Framework for Modeling, Optimizing, and Implementing DNNs on FPGA Using HLS</td><td>4-4 Implementation of an active-filtering circuit for electroencephalographic signal acquisition using an 8-bit microcontroller</td></tr>
<tr><td>2:45</td><td colspan="6">Break</td></tr>
<tr><td>3:00</td><td>Keynote Speaker # 3
Session Chair: Oren Eliezer
Co-Chair: Farzaneh Jalali
(Room # 1)</td><td colspan="2">DR. ROOZBEH JAFARI</td><td colspan="3">Cuffless Blood Pressure Monitoring using Bio-Impedance Circuits and Systems</td></tr>
<tr><td></td><td colspan="6">Break</td></tr>
<tr><td>4:15</td><td>Industrial Presentation</td><td># 1</td><td colspan="2">Dr. Scott Hanson</td><td colspan="2">Toward Endpoint AI: Enabling Coin Cell Virtual Assistants and Wrist-Worn Doctors With SPOT</td></tr>
<tr><td>5:00</td><td colspan="6">End of Day 1</td></tr>
</table>

NOVEMBER 16, 2020

Start time	Session		Paper #	Presentation/Paper Title		Paper #	Presentation/Paper Title
9:30							
9:45	Keynote Speaker # 4 Session Chair: Hadi Heidari Co-Chair: Olivia Huang (Room # 1)	DR. BOGDAN R. STASZEWSKI		Quantum Computer on a CMOS Chip			
10:45	Break						
11:00	Session # 5 Session Chair: Mahshid Naeini Co-Chair: Olivia Huang (Room # 1)		Paper #	**5-1** Noise Reduction via Chopper Stabilization of Fully Differential Temperature Sensors for Hardware Security Applications	Session # 6 Session Chair: Joseph Friedman Co-Chair: Alec Steele (Room # 2)	Paper #	**6-1** Linearity Enhancement Using a Common-Drain Topology for Envelope Tracking CMOS Power Amplifiers
11:15				**5-2** 28 GHz Front End with Duplexer in 40 nm CMOS Technology for 5G Beam-steering Transceivers			**6-2** ExTru: A Lightweight, Fast, and Secure Expirable Trust for the Internet of Things
11:30				**5-3** A Low-Power Front-End with Compressive Sensing Circuit for Neural Signal Acquisition designed in 180 nm CMOS process			**6-3** Highly Efficient Rectifier And DC-DC Converter Designed in 180 nm CMOS Process for Ultra-Low Frequency Energy Harvesting Applications
11:45				**5-4** A Broadband Class AB Power Amplifier with Second Harmonic Injection			**6-4** Design of an Enhanced Reconfigurable Chaotic Oscillator using G4FET-NDR Based Discrete Map
12:00	Lunch break						
12:30	Keynote Speaker # 5 Session Chair: Benjamin Schaefer Co-Chair: Olivia Huang (Room # 1)	DR. TINOOSH MOHSENIN		Micro AI: When Intelligence Moves to the Low Power Sensors			

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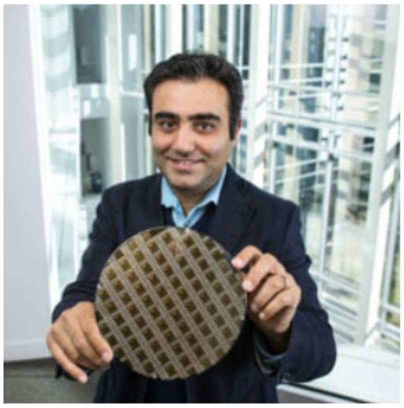
13:30	**Break**					
1:45	**Session # 7** **Session Chair: Gayatri Mehta** **Co-Chair: Olivia Huang** **(Room # 1)**	**Paper #**	**7-1** Magneto-electric Transistor Devices and Circuits with Steering Logic	**Session # 8** **Session Chair: TBA** **Co-Chair: Alec Steele** **(Room # 2)**	**Paper #**	**8-1** Word recognition clinical testing of personalized deep reinforncement learning compression
2:00			**7-2** ACPA: Robust Implementation of Memristive Reservoir Computing with Crossbar Based Readout Layer			**8-2** Deep Learning Deployment
2:15			**7-3** Low Power Fully Differential CMOS First-Order All-Pass Filter with 0.2- 4.8Hz Variable Pole Frequency			**8-3** Low Power Implementation of ECG R-wave Peak Detector in 180nm
2:30			**7-4** Design of a Dynamic Parameter-Controlled Chaotic-PRNG in a 65 nm CMOS process			
2:45	**Break**					
3:00	**Industrial Presentation** **Session Chair: Andrew Marshall** **Co-Chair: Olivia Huang** **(Room # 1)**	**# 1**	**Dr. Fengyuan (Max) Deng**		**Moku:Lab Lock-in Amplifier and Its Use in Optics and Photonics**	
4:00	**Industrial Presentation** **Session Chair: TBA** **Co-Chair: Olivia Huang** **(Room # 1)**	**# 2**	**Dr. Paul Cracknell**		**Frequency Response Analyzers:** **a flexible instrument on a flexible platform**	
5:00	**End of Day 2**					

KEYNOTE SPEAKERS



DR. HOUMAN HOMAYOUN

DATE AND LINK: NOVEMBER 15, 2020, 12:30 P.M. CENTRAL TIME

Title: Towards Hardware Cybersecurity
Affilitation: Associate Professor, Electrical and Computer Engineering Department, University of California Davis

Abstract: Electronic system security, trust and reliability has become an increasingly critical area of concern for modern society. Secure hardware systems, platforms, as well as supply chains are critical to industry and government sectors such as national defense, healthcare, transportation, and financial. Traditionally, authenticity and integrity of data has been protected with various security protocol at the software level with the underlying hardware assumed to be secure, and reliable. This assumption however is no longer true with an increasing number of attacks reported on the hardware. Counterfeiting electronic components, inserting hardware trojans, and cloning integrated circuits are just few out of many malicious byproducts of hardware vulnerabilities, which need to be urgently addressed. In the first part of this talk I will address the security and vulnerability challenges in the horizontal integrated hardware development process. I will then present the concept of logic obfuscation through using hybrid spin-transfer torque CMOS look up tables which is our latest effort on developing a cost-effective solution to prevent physical reverse engineering attacks. In the second part of my talk I will present how information at the hardware level can be used to address some of the major challenges of software security vulnerabilities monitoring and detection methods. I will first discuss these challenges and will then show how the use of microarchitecture data at the hardware level in combination with an effective machine learning based predictor helps protecting systems against various classes of hardware vulnerability attacks. I will conclude the talk by emphasizing the importance of this emerging area and proposing a research agenda for the future.

Bio:

Houman Homayoun is currently an Associate Professor in the Department of Electrical and Computer Engineering at University of California, Davis. He is also the director of National Science Foundation Center for Hardware and Embedded Systems Security and Trust (CHEST). Prior to that he was an Associate Professor in the Department of Electrical and Computer Engineering at George Mason University (GMU). From 2010 to 2012, he spent two years at the University of California, San Diego, as NSF Computing Innovation (CI) Fellow awarded by the CRA-CCC. Houman graduated in 2010 from University of California, Irvine with a Ph.D. in Computer Science. He was a recipient of the four-year University of California, Irvine Computer Science Department chair fellowship. Houman received the MS degree in computer engineering in 2005 from University of Victoria and BS degree in electrical engineering in 2003 from Sharif University of Technology. He is currently the director of UC Davis Accelerated, Secure, and Energy-Efficient Computing Laboratory (ASEEC). Houman conduct research in hardware security and trust, data-intensive computing and heterogeneous computing, where he has published more than 100 technical papers in the prestigious conferences and journals on the subject and directed over $8M in research funding from NSF, DARPA, AFRL, NIST and various industrial sponsors. His work received several best paper awards and nominations in various conferences including GLSVLSI 2016, ICDM 2019, and ICCAD 2019, and 2020. Houman served as

Member of Advisory Committee, Cybersecurity Research and Technology Commercialization (RTC) working group in the Commonwealth of Virginia in 2018. Since 2017 he has been serving as an Associate Editor of IEEE Transactions on VLSI. He was the technical program co-chair of GLSVLSI 2018 and the general chair of 2019 conference.

DR. BERNHARD WICHT

DATE AND LINK: NOVEMBER 15, 2020, 9:45 A.M. CENTRAL TIME

Title: Tiny and Efficient – Power Management as a Key Function in Microelectronic Systems

Affilitation: Professor at the Institute of Microelectronic Systems, Leibniz University Hannover

Abstract: Power management comprises integrated circuits for highly efficient power supplies and for controlling power switches. These have recently gained tremendous importance in order to make electronic solutions for global growth areas such as renewable energies, autonomous driving and biomedical more compact, more energy-efficient and more reliable. Future applications in the field of machine learning and AI will only be possible with intelligent power management to supply complex processors and sensors. This talk gives an overview at system and circuit level of current and future challenges, along with examples including the topics of automotive, wearables, GaN, and current measurement.

Bio:

Bernhard Wicht has 20+ years of experience in analog and power management IC design. He received the Dipl. Ing. degree in electrical engineering from University of Technology Dresden, Germany, in 1996 and the Ph.D. degree (Summa Cum Laude) from University of Technology Munich, Germany, in 2002. Between 2003 and 2010, he was with Texas Instruments, Freising, Germany, responsible for the design of automotive power management ICs. In 2010, he became a full professor for integrated circuit design and a member of the Robert Bosch Center for Power Electronics at Reutlingen University, Germany. Since 2017, he has been heading the Chair for Mixed-Signal IC Design at Leibniz University Hannover, Germany. His research interest includes IC design with focus on power management, gate drivers and high-voltage ICs. Dr. Wicht was co-recipient of the 2015 ESSCIRC Best Paper Award and of the 2019 First Prize Paper Award of the IEEE Journal of Emerging and Selected Topics in Power Electronics. In 2018, he received the faculty award for excellent teaching at his university. He invented seventeen patents with several more pending. He is currently a member of the Technical Program Committee of ISSCC and he is also a Distinguished Lecturer of the IEEE Solid-State Circuits Society.

DR. TINOOSH MOHSENIN

DATE AND LINK: NOVEMBER 16, 2020, 12:30 P.M. CENTRAL TIME

Title: Micro AI: When Intelligence Moves to the Low Power Sensors

Affilitation: Associate Professor of Computer Science and Electrical Engineering, University of Maryland

Abstract: Artificial intelligence is being used in a variety of edge-computing devices such as biomedical sensors, wearables and autonomous systems. Processing these sensor-level machine learning tasks come at the cost of high computational complexity and memory storage which is overwhelming for these light weight and battery constrained devices. Equally important is the need for designing smarter AI systems that can reason over in the face of a highly variable and unpredictable world. This talk overviews some research solutions that enable performing data analytics from a variety of multimodal sensors in real time while consuming low power. I will also talk about adding reasoning in these systems to improve acting and learning performance. Combining these solutions will bring exciting opportunities for future micro AI processors.

Bio:

Tinoosh Mohsenin is an Associate Professor in the Department of Computer Science and Electrical Engineering at UMBC and Director of the Energy Efficient High Performance Computing Lab. Prof. Mohsenin's research focus is on designing low power processors for high computational machine learning and knowledge extraction techniques used in wearables, Interment of Things and Autonomous systems. She has over 100 peer-reviewed journal and conference publications and is the recipient of NSF CAREER award in 2017, the best paper award in the ACM Great Lakes VLSI conference 2016, and the best paper honorable award in the IEEE Circuits and Systems Symposium 2017 for developing processors in biomedical and deep learning. She has previously served as Associate Editor in IEEE Transactions on Circuits and Systems-I (TCAS-I) and IEEE Transactions on Biomedical Circuits and Systems (TBioCAS). She served at the General Chair, Program Chair of 29th and 30th Editions of ACM Great Lake VLSI conference in 2019 and 2020, respectively. She was also the Local Arrangement Chair for the 50th Edition of IEEE ISCAS conference. She has been the Plenary Speaker at the IEEE AICAS 2020 and IEEE ICECS 2020, conferences.

DR. ROOZBEH JAFARI

DATE AND LINK: NOVEMBER 15, 2020, 3 P.M. CENTRAL TIME

Title: Cuffless Blood Pressure Monitoring using Bio-Impedance Circuits and Systems

Affilitation: Professor of Biomedical Engineering, Computer Science and Engineering and Electrical and Computer Engineering at Texas A&M University

Abstract: Continuous and robust monitoring of physiological signals with wearable devices provides new opportunities for improving the care for people with or at risk of a broad range of adverse health events. One challenge has been that many devices are obtrusive, cumbersome, and unsuitable for ambulatory care. Limited reliability and robustness of these sensing paradigms have also been among contributing factors that has been prohibiting their widespread adoption. Another challenge associated with the measurement of certain hemodynamic parameters, such as blood pressure (BP), is that cuff-based sensors are only capable of providing infrequent measurements. Elevated BP is a critically important risk factor for various cardiovascular disorders (i.e., heart attack, stroke, heart failure), kidney diseases, vision loss, and sexual dysfunction. In this talk, we discuss our techniques that directly address these unmet needs for a device that can unobtrusively, accurately, and continuously measure BP. We seek to develop and test a novel transformative solution, leveraging bio-impedance, which addresses concerns of wearability and robust sensing, and enables new sensing paradigms that can be deployed for field-based, mobile, or ambulatory care. We will discuss a number of sensing, circuit and signal processing paradigms that capture physiological observations including bio-impedance. Our primary focus remains estimating BP from a wrist-worn device with a small watch form factor with high degrees of precision. Several methodologies for noise rejection that improve the robustness of signal acquisition, as well as machine learning techniques that convert the bio-impedance observations to BP, will be presented, including the trends of wearable computing technology development and potential future directions.

Bio:

Roozbeh Jafari is a professor of Biomedical Engineering, Computer Science and Engineering and Electrical and Computer Engineering at Texas A&M University. He received his Ph.D. in Computer Science from UCLA and completed a postdoctoral fellowship at UC-Berkeley. His research interests lie in the areas of wearable computer design and signal processing. He has so far raised more than $87M for research with $28M directed towards his lab. His research has been funded by the NSF, NIH, DoD (TATRC, DTRA, DIU), AFRL, AFOSR, DARPA, SRC and the industry (Texas Instruments, Tektronix, Samsung & Telecom Italia). He has published over 180 papers in refereed journals and conferences and has served as the general chair and technical program committee chair for several flagship conferences in the area of Wearable Computers. Dr. Jafari is the recipient of the NSF CAREER award (2012), IEEE Real-Time & Embedded Technology & Applications Symposium best paper award (2011), Andrew P. Sage best transactions paper award (2014), ACM Transactions on Embedded Computing Systems best paper award (2019), and the outstanding engineering contribution award from the College of Engineering at Texas A&M (2019). He was named Texas A&M Presidential Impact Fellow (2019). He is an associate editor for the IEEE Transactions on Biomedical

Circuits and Systems, IEEE Sensors Journal, IEEE Internet of Things Journal, IEEE Journal of Biomedical and Health Informatics and ACM Transactions on Computing for Healthcare. He frequently serves on scientific panels for funding agencies and is presently serving as a standing member of the NIH Biomedical Computing and Health Informatics study section and as the chair of the Clinical Informatics and Digital Health study section.

DR. ROBERT BOGDAN STASZEWSKI

DATE AND LINK: NOVEMBER 16, 2020, 9:45 A.M. CENTRAL TIME

Title: Quantum Computer on a CMOS Chip
Affilitation: Professor of Electrical & Electronic Engineering at University College Dublin

Abstract: Quantum computing is a new paradigm that exploits fundamental principles of quantum mechanics, such as superposition and entanglement, to tackle problems in mathematics, chemistry and material science that are well beyond the reach of supercomputers. Despite the intensive worldwide race to build a useful quantum computer, it is projected to take decades before reaching the state of useful quantum supremacy. The main challenge is that qubits operate at the atomic level, thus are extremely fragile, and difficult to control and read out. The current state-of-art implements a few dozen magnetic-spin based qubits in a highly specialized technology and cools them down to a few tens of millikelvin. The high cost of cryogenic cooling prevents its widespread use. A companion classical electronic controller, needed to control and read out the qubits, is mostly realized with room-temperature laboratory instrumentation. This makes it bulky and nearly impossible to scale up to the thousands or millions of qubits needed for practical quantum algorithms. We propose a new quantum computer paradigm that exploits the wonderful scaling achievements of mainstream integrated circuits (IC) technology which underpins personal computers and mobile phones. Just like with a small IC chip, where a single nanometer-sized CMOS transistor can be reliably replicated millions of times to build a digital processor, we propose a new structure of a qubit realized as a CMOS-compatible charge-based quantum dot that can be reliably replicated thousands of times to construct a quantum processor. Combined with an on-chip CMOS controller, it will realize a useful quantum computer which can operate at a much higher temperature of 4 kelvin. Preliminary experimental result appear to validate the proposed ideas.

Bio:

R. Bogdan Staszewski received B.S. (summa cum laude), M.S. and PhD from University of Texas at Dallas, USA, in 1991, 1992 and 2002, respectively. From 1991 to 1995 he was with Alcatel in Richardson, Texas. He joined Texas Instruments in Dallas, Texas in 1995. In 1999 he co-started a Digital RF Processor (DRP) group in TI with a mission to invent new digitally intensive approaches to traditional RF functions. Dr. Staszewski served as a CTO of the DRP group between 2007 and 2009. In July 2009 he joined Delft University of Technology in the Netherlands where he is currently a part-time Full Professor. Since Sept. 2014 he is a Full Professor at University College Dublin (UCD) in Ireland. He has co-authored five books, eight book chapters, 110 journal and 200 conference publications, and holds 190 issued US patents. His research interests include nanoscale CMOS architectures and circuits for frequency synthesizers, transmitters and receivers, as well as quantum computers. He is a co-founder of a startup company Equal1 Labs aiming at building the first practical CMOS quantum computer. He is an IEEE Fellow and a recipient of IEEE Circuits and Systems Industrial Pioneer Award (http://ieee-cas.org/industrial-pioneer-award-recipients). He was the Chair of the

Technical Program Committee (TPC) of the IEEE Dallas Circuits and Systems Workshop, from 2005 to 2008. He was a TPC Chair of IEEE European Solid-State Circuits Conference (ESSCIRC) in 2019 in Krakow, Poland

INDUSTRY PRESENTATION

DR. FENGYUAN (MAX) DENG

LIQUID INSTRUMENTS
Title: Moku:Lab Lock-in Amplifier and Its Use in Optics and Photonics

Summary: Max will highlight the key attributes of the Moku:Lab platform – design philosophy and how it's different. Explain the Lock-in Amplifier instrument, operation principle and its use in optics and photonics Example use case 1: Ultrafast spectroscopy and microscopy: toward high frequency demodulation. Example use case 2: Nonlinear absorption and atomic force microscopy: higher harmonic demodulation. Example use case 3: Laser frequency stabilization: optical phase- locked loop implementation.

Bio:

Fengyuan (Max) Deng is an application engineer at Liquid Instruments. His work is focused on the use of Moku:Lab - an FPGA-based test and measurement instrument - in cutting edge optics and photonics related research. Max got his Ph.D. in analytical chemistry at Purdue University. He was a postdoc fellow at Boston University before he joined Liquid Instruments. His research was primarily focused on nonlinear optics based chemical imaging.

PAUL CRACKNELL

LIQUID INSTRUMENTS

Title: Frequency Response Analyzers: a flexible instrument on a flexible platform

Summary: Frequency response analyzers are used in a variety of applications in the electronic engineering lab and biochemistry. At their core, they drive a swept frequency sine wave and measure the resulting amplitude and phase. This allows measurements of impedance of passive components or active filter responses; system stability or power supply loop response. In this presentation we will review a couple of applications of an FRA and include a video demo using Moku:Lab.

Bio:

Paul has a depth of experience in the fields of FPGAs, ASICs and test engineering over more than 15 years. With a background of ASIC design at Nokia and an extensive background at Qualcomm in the application engineering and product test areas; Paul is excited to be part of the new developments of test and measurement of Moku:Lab at Liquid Instruments.

DR. SCOTT HANSON

AMBIQ
Title: Toward Endpoint AI: Enabling Coin Cell Virtual Assistants and Wrist-Worn Doctors With SPOT

Summary: The emergence of deep learning AI has spurred a renaissance in semiconductor development. However, most of the attention and resources are going to cloud-based and edge-based AI solutions. Meanwhile, there are billions of small, low cost (and often battery powered) endpoint devices that have a strong need for AI capabilities. Unlike their cloud and edge counterparts, these endpoint devices have extreme resource constraints. Every microwatt, cent, megahertz, and kilobyte matters. In this talk, I will discuss these constraints and show how Ambiq's ground-breaking Sub-threshold Power Optimized Technology (SPOT) helps make endpoint AI possible. This technology is enabling incredible devices like virtual assistants that can run for a year on a coin cell battery and AI doctors that can live in always-on wearables. I'll end with a look to the future and to areas that need rapid innovation for an exciting endpoint AI future.

Bio:

Dr. Scott Hanson earned his BS, MS, and PhD degrees at the University of Michigan in 2004, 2006 and 2008, respectively. His research with Prof. Dennis Sylvester and Prof. David Blaauw was on variation-tolerant low voltage circuits, based on which several picowatt-class microprocessors for medical implants were demonstrated. This technology is what was eventually commercialized at Ambiq, which Scott founded in 2010. At Ambiq Scott has served a variety of roles including CEO and VP of Engineering. He currently serves as CTO and is responsible for product and technology roadmaps and drives the company strategy.

Technical Papers Published with IEEE Xplore (organized by sessions)

1. Analog IC Design, Modeling and Testing

1-1 1.37A,2A Current Regulating High Side Driver With 0.4ÂµJ Energy Limitation During Unpowered State

Sri Navaneeth Easwaran (Texas Instruments Inc), Robert Weigel (University of Erlangen-Nuremberg)

1-2 Advanced Non-linear Control Technique for Current-Fed Full-Bridge DC-DC Converter

Sameer Arora (University of Texas at Dallas), Poras Balsara (University of Texas at Dallas), Dinesh Bhatia (University of Texas at Dallas)

1-3 A Novel Modulation Method to Reduce Leakage Current in Transformerless Z-source PV Inverters

Armin Abadifard (University of Tabriz), Pedram Ghavidel (University of Tabriz), Nima Taherkhani (University of Texas at Dallas), Mehran Sabahi (University of Tabriz)

1-4 Ternary Limited-Weight Codes and Quaternary Transition-Signaling for Low-Power Bus Encoding

Maryam Sadat Hosseini Omshi (North Tehran Branch, Islamic Azad University), Reza Faghih Mirzaee (Shahr-e-Qods Branch, Islamic Azad University)

2-1 Neural Network-Based Mitigation of Nonlinear In-band Distortion in Coded OFDM System

Nima Taherkhani (University of Texas at Dallas), Kamran Kiasaleh (UT Dallas)

2-2 Clipping Noise Mitigation by Adaptive Nulling and Nondata-Aided Compensation in Coded OFDM

Nima Taherkhani (University of Texas at Dallas), Kamran Kiasaleh (UT Dallas)

2-3 Data Flow Mapping onto DNN Accelerator Considering Hardware Cost

Baharealsadat Parchamdar (Islamic Azad University of Science and Research Branch), Midia Reshadi (Islamic Azad University of Science and Research Branch)

2-4 The Characterization and Assembly of an Efficient Cost Effective Focused Ultrasound Transducer

Michael Maslakowski (Pennsylvania State University), Sheikh Ilham (Pennsylvania State University), Timothy Hall (University of Michigan), Thyagarajan Subramanian (Pennsylvania State University), Mehdi Kiani (Penn State University), Mohamed Almekkawy (Pennsylvania State University)

3-1 Formal Verification of Non-Functional Strategies of System-Level Power Management Architecture in Modern Processors

Reza Sharafinejad (University of Tehran), Bijan Alizadeh (University of Tehran),Tooraj Nikoubin (University of Texas at Dallas)

3-2 ACPA: Exploiting Approximate Computing for High-Level Imprecision Optimization of Fixed-point LTI systems

Mahdieh Grailoo (University of Tehran), Bijan Alizadeh (University of Tehran), Tooraj Nikoubin (University of Texas at Dallas)

3-3 Custom Real-Time-Kinematics Positioning System Testbed for Mobile Robot Localization

Theodore Stangebye (Baylor University), Timothy Mohr (Grove City College), Scott Koziol (Baylor University); Anna Valenti (Grove City College), Matthew Grauff (Grove City College)

3-4 A Framework for Modeling, Optimizing, and Implementing DNNs on FPGA Using HLS

Masoud Shahshahani (university of texas at dallas), Bahareh Khabazan (Iran University of Technology), Mohammad Sabri (Iran University of Technology), Dinesh Bhatia (University of Texas at Dallas)

4-1 Study the Effects of Misalignments in the Printed Spiral Inductive Coils for the Passive Wearable Sensors

Babak Noroozi (FAMU-FSU College of Engineering), Bashir Morshed (University of Memphis)

4-2 A Miniaturized High-efficient Headstage Based WPT System for Optogenetic Stimulation of Freely Moving Animal

Dipon Biswas (University of North Texas), Ishani Kaul (Frisco Independent School District), Arnav Kaul (Frisco Independent School District), Ifana Mahbub (University of North Texas)

4-3 Study on impact of process on Bitcell design in FinFets

Mohammad Anees (Xilinx), Kumar Rahul (XILINX), Sourabh Swarnkar (Xilinx, Inc.), Santosh Yachareni (Xilinx, Inc.)

4-4 Implementation of an active-filtering circuit for electroencephalographic signal acquisition using an 8-bit microcontroller

Jose Perez Galindo (Universidad de Ingeniería y Tecnología - UTEC), Jimmy Fernando Tarrillo Olano (Universidad de Ingeniería y Tecnología - UTEC)

5-1 Noise Reduction via Chopper Stabilization of Fully Differential Temperature Sensors for Hardware Security Applications

Haoran Wei (Northeastern University), Mengting Yan (Northeastern University), Marvin Onabajo (Northeastern University)

5-2 28 GHz Front End with Duplexer in 40 nm CMOS Technology for 5G Beam-steering Transceivers

Panagiotis Gkoutis (University of Patras), Georgios Konidas (University of Patras), Grigorios Kalivas (Nil)

5-3 A Low-Power Front-End with Compressive Sensing Circuit for Neural Signal Acquisition designed in 180 nm CMOS process

Karthik Kakaraparty (university of north texas), Ifana Mahbub (University of North Texas), Nishat Tarannum Tasneem (University of North Texas)

5-4 A Broadband Class AB Power Amplifier with Second Harmonic Injection

Pouria Pazhouhesh (Arizona State University), Jennifer Kitchen (Arizona State University)

6-1 Linearity Enhancement Using a Common-Drain Topology for Envelope Tracking CMOS Power Amplifiers

SUMIT BHARDWAJ (ARIZONA STATE UNIVERSITY), Soroush Moallemi (Alphacore Inc.), Jennifer Kitchen (Arizona State University)

6-2 ExTru: A Lightweight, Fast, and Secure Expirable Trust for the Internet of Things

Hadi Mardani Kamali (George Mason university), Kimia Zamiri Azar (George Mason University), Shervin Roshanisefat (George Mason University), Ashkan Vakil (George Mason University), Houman Homayoun (University of California Davis); Avesta Sasan (George Mason University)

6-3 Highly Efficient Rectifier And DC-DC Converter Designed in 180 nm CMOS Process for Ultra-Low Frequency Energy Harvesting Applications

Avinash Gunti (University of North Texas), Dipon Biswas (University of North Texas), Pashupati Adhikari (University of North Texas), Russel Reid (Dixie State university), Ifana Mahbub (University of North Texas)

6-4 Design of an Enhanced Reconfigurable Chaotic Oscillator using G4FET-NDR Based Discrete Map

Partha Sarathi Paul (University of Mississippi), Maisha Sadia (University of Mississippi), Md Sakib Hasan (University of Mississippi)

7-1 Magneto-electric Transistor Devices and Circuits with Steering Logic

Andrew Marshall (University of Texas at Dallas), Peter Dowben (University of Nebraska at Lincoln)

7-2 Robust Implementation of Memristive Reservoir Computing with Crossbar Based Readout Layer

Sagarvarma Sayyaparaju (The University of Tennessee, Knoxville), Mst Shamim Ara Shawkat (The University of Tennessee, Knoxville), Garrrett Rose (University of Tennesseee)

7-3 Low Power Fully Differential CMOS First-Order All-Pass Filter with 0.2- 4.8Hz Variable Pole Frequency

Venkata Deepa Kota (University of North Texas), Nishat Tarannum Tasneem (University of North Texas),Ifana Mahbub (University of North Texas), Nishat Tarannum Tasneem (University of North Texas)

7-4 Design of a Dynamic Parameter-Controlled Chaotic-PRNG in a 65 nm CMOS process

Md Sakib Hasan (University of Mississippi), Aysha Shanta (University of Tennesseee), Partha Sarathi Paul (University of Mississippi), Maisha Sadia (University of Mississippi), Md Badruddoja Majumder (University of Tennesseee), Garrrett Rose (University of Tennesseee)

8-1 Word recognition clinical testing of personalized deep reinforncement learning compression

Sara Akbarzadeh (The University of Texas at Dallas), Nasim Alamdari (University of Texas at Dallas), Christina Campbell (University of Texas at Dallas), Edward Lobarinas (University of Texas at Dallas), Nasser Kehtarnavaz (University of Texas at Dallas)

8-2 Deep Learning Deployment

Shailesh Nirgudkar (Mathworks)

8-3 Low Power Implementation of ECG R-wave Peak Detector in 180nm

Anindita Paul (Manhattan College), edit Jaime Ramirez-Angulo (New Mexico State University), Antonio Lopez (Nil), Ramón González Carvajal (University of Seville), Alejandro Diaz-Sanchez (Nil)

THANK YOU