

# Mingoo Seok

Mingoo Seok  
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Electrical Engineering  
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**Date:** April 2019

## Education

<u>School</u>	<u>Degree</u>	<u>Date</u>
University of Michigan, Ann Arbor, MI, USA	Ph.D.	2007-2010
University of Michigan, Ann Arbor, MI, USA	M.S	2005-2007
Seoul National University, Seoul, South Korea	B.S. with <i>summa cum laude</i>	1998-2005
Seoul Science High School, Seoul, South Korea	<i>summa cum laude</i>	1995-1998

## Title of Ph.D. Thesis

[Extreme Power-Constrained IC Design](#)

## Principal Field of Interest

Very large scale integration (VLSI) hardware design

Seok's expertise is to design general-purpose and specialized computing and sensing systems in the form of integrated circuits. The foci are given to: ultra-low power/voltage circuits, variation tolerant and better-than-worst-case design, dynamic thermal and reliability management, integrated power management, hybrid analog digital computing, and artificial-intelligence hardware and systems.

## Career History

<u>Employer</u>	<u>Position</u>	<u>Beginning</u>	<u>Ending</u>
Columbia University	Associate Professor	Mar. 2018	present
Columbia University	Assistant Professor	Jan. 2016	Feb. 2018
Texas Instruments, Dallas	Member of Technical Staff	Jan. 2011	Nov. 2011
University of Michigan, Ann Arbor	Research Assistant	Jan. 2006	Dec. 2010

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## Awards/Honors Received

- (9) Qualcomm Faculty Award (2019)
- (8) IEEE Senior Member (2018); Member (2012); Student Member (2006)
- (7) NSF CAREER Award - Awarded for "Addressing Deepening Variability Challenges for Next Generation Margin Free VLSI Computing Platform Design," 2015
- (6) AMD/CICC Student Scholarship Award - Awarded for "A 0.5V 2.2pW 2-Transistor Voltage Reference", US, Aug. 2009
- (5) DAC/ISSCC Student Design Contest - Awarded for "Phoenix: an Ultra-Low Power Processor for Cubic Millimeter Sensor Systems", US, Feb. 2009
- (4) Rackham Pre-doctoral Fellowship - One of three recipients in the EECS department, University of Michigan, Ann Arbor, US, Sep.2008-Aug. 2009
- (3) Doctoral Study Abroad Fellowship - One of 15 recipients, nationally, Korea Foundation for Advanced Studies, South Korea, Sep.2005-Aug. 2007
- (2) Excellency Fellowship - Seoul National University, South Korea, Mar.1998-Mar.2001
- (1) Distinguished Undergraduate Scholarship - One of 20 recipients, nationally, Korea Foundation for Advanced Studies, South Korea, Sep. 1999 - Feb. 2002

## Publications

- Total number of publications = 33 (Journal), 76 (conference); h-index = 24; i10-index = 41; total citation count = 2600 (3/2019); based on the Google Scholar
- *h-index*: a scholar with an index of  $h$  has published  $h$  papers each of which has been cited in other papers at least  $h$  times; *i10-index*: the number of publications with at least 10 citations; *h5-index*: h5-index is the h-index for articles published in the last 5 complete years. It is the largest number  $h$  such that  $h$  articles published in last five years have at least  $h$  citations each;

### Papers in Referred Journals

#### 2019

- (33) Seongjong Kim, Joao Pedro Cerqueira, Mingoo Seok, "A Near-Threshold Spiking Neural Network Accelerator with a Body-Swapping based In-Situ Error Detection and Correction Technique," *IEEE Transactions of Very Large Scale Integration Systems (TVLSI)*, 2019, h5-index: 44
- (32) Tianchan Guan, Peiye Liu, Xiaoyang Zeng, Martha Kim, Mingoo Seok, "Recursive Binary Neural Network Training Model for Efficient Usage of On-Chip Memory," *IEEE Transactions on Circuits and Systems I (TCAS-I)*, 2018, h5-index: 56
- (31) Minhao Yang, Chung-Heng Yeh, Yiyin Zhou, Joao Pedro Cerqueira, Aurel A. Lazar, Mingoo Seok, "Design of an Always-On Deep Neural Network Based  $1 \mu W$  Voice Activity Detector Aided with a Customized Software Model for Analog Feature Extraction," *IEEE Journal of Solid-State Circuits (JSSC)*, 2018, h5-index: 69

#### 2018

- (30) Joao Pedro Cerqueira, Jianguyi Li, Mingoo Seok, "A fW- and kHz-Class Feedforward Leakage Self-Suppression Logic Requiring No External Sleep Signal to Enter the Leakage Suppression Mode," *IEEE Solid-State Circuits Letter (SSCL)*, 2018, h5-index: new journal
- (29) Tianchan Guan, Xiaoyang Zeng, Mingoo Seok, "Recursive Synaptic Bit Reuse: An Efficient Way to Increase Memory Capacity in Associated Memory," *IEEE Transactions on VLSI Systems (TVLSI)*, 2018, h5-index: 44
- (28) Sung Justin Kim, Doyun Kim, Jonghwan Kim, Hyunju Ham, Mingoo Seok, "A Fully-Integrated Digital LDO based on Hybrid Event- and Time-Driven Control," *IEEE Solid State Circuits Letter (SSCL)*, 2018, h5-index: new journal
- (27) Teng Yang, Doyun Kim, Jianguyi Li, Peter R. Kinget, Mingoo Seok, "In-Situ and In-Field Technique for Monitoring and Decelerating NBTI in 6T-SRAM Register Files," *IEEE Transactions of Very Large Scale Integration Systems (TVLSI)*, 2018, h5-index: 44
- (26) Seongjong Kim, Mingoo Seok, "A Sub-50 $\mu\text{m}^2$ , Voltage-Scalable, Digital-Standard-Cell-Compatible Thermal Sensor Frontend for On-Chip Thermal Monitoring," *Journal of Low Power Electronics and Applications - Special Issue on CMOS Low Power Design*, 2018, h5-index: 10
- (25) Jianguyi Li, Teng Yang, Minhao Yang, Peter R. Kinget, Mingoo Seok, "An Area-Efficient Microcontroller-SoC with an Instruction-Cache Transformable to a Temperature Sensor and a Physically Unclonable Function," *IEEE Journal of Solid-State Circuits (JSSC)*, 2018, invited for the special issue, h5-index: 69

#### 2017

- (24) Doyun Kim, Mingoo Seok, "A Fully-Integrated Digital Low-Drop-Out Regulator based on Event-Driven Explicit-Time-Coding Architecture," *IEEE Journal of Solid-State Circuits (JSSC)*, 2017, h5-index: 69
- (23) Wei Jin, Seongjong Kim, Weifeng He, Zhigang Mao, Mingoo Seok, "Near and Sub-Vt Pipelines based on Wide-Pulsed-Latch Design Techniques," *IEEE Journal of Solid-State Circuits (JSSC)*, 2017, h5-index: 69
- (22) Jianguyi Li, Jae-Sun Seo, Ioannis Kymissis, Mingoo Seok, "Triple-Mode, Hybrid-Storage Energy Harvesting Power Management Unit: Achieving High Efficiency against Harvesting and Load Variabilities," *IEEE Journal of Solid-State Circuits (JSSC)*, 2017, invited for the special issue, h5-index: 69
- (21) Yipeng Huang, Ning Guo, Mingoo Seok, Yannis Tsividis, Simha Sethumadhavan, "Analog Computing in a Modern Context: A Linear Algebra Accelerator Case Study," *IEEE MICRO Magazine*, 2017, **Top Picks from the Computer Architecture Conferences**, h5-index: 28

#### 2016

- (20) Wei Jin, Seongjong Kim, Weifeng He, Zhigang Mao, Mingoo Seok, "In-Situ Error Detection Technique in Ultra-Low-Voltage Pipelines: Analysis and Optimizations," *IEEE Transactions on VLSI Systems (TVLSI)*, 2016, h5-index: 44, [link](#)
- (19) Jianguyi Li, Mingoo Seok, "Ultra-Compact and Robust Physically-Unclonable-Function based on Voltage-Compensated Proportional-to-Absolute-Temperature Voltage Generators," *IEEE Journal of Solid-State Circuits (JSSC)*, 2016, h5-index: 69, [link](#)
- (18) Le Zheng, Zhenzhi Wu, Mingoo Seok, Xiaodong Wang, Quanhua Liu, "High-Accuracy Compressed Sensing Decoder Based on Adaptive ( $l_0, l_1$ ) Complex Approximate Message Pass-

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ing: Cross-Layer Design, *IEEE Transactions on Circuits and Systems I (TCAS-I)*, 2016, h5-index: 56, [link](#)

- (17) Daniel Marti, Mattia Rigotti, Mingoo Seok, Stefano Fusi, "Energy-Efficient Neuromorphic Classifier," *Neural Computation (NECO)*, 2016, h5-index: 34, preprint is uploaded at [ArXiv](#)
- (16) Ning Guo, Yipeng Huang, Tao Mai, Shavil Patil, Chi Cao, Mingoo Seok, Simha Sethumadhavan, Yannis Tsividis, "Low-Energy Hybrid Analog/Digital Approximate Computation in Continuous Time," *IEEE Journal of Solid-State Circuits (JSSC)*, 2016, invited for the special issue, h5-index: 69, [link](#)
- (15) Joao Pedro Cerqueira, Mingoo Seok, "Temporarily Fine-Grained Sleep Technique for Near- and Sub-Threshold Parallel Architectures," *IEEE Transactions on VLSI Systems (TVLSI)*, 2016, h5-index: 44, [link](#)

#### 2015

- (14) Teng Yang, Seongjong Kim, Peter R. Kinget, Mingoo Seok, "Ultra-compact and Voltage-Scalable Temperature Sensor Design for Dense Dynamic Thermal Management Techniques," *IEEE Journal of Solid-State Circuits (JSSC)*, 2015, h5-index: 69, [link](#)
- (13) Seongjong Kim, Mingoo Seok, "Variation-Tolerant Near-threshold Microprocessor Design with Low-Overhead, Within-a-Cycle In-situ Error Detection and Correction Technique," *IEEE Journal of Solid-State Circuits (JSSC)*, 2015, h5-index: 69, [link](#)

#### 2013

- (12) Yoonmyung Lee, Mingoo Seok, Scott Hanson, Dennis Sylvester, David Blaauw, "Achieving Ultra-low Standby Power with an Efficient SCCMOS Bias Generator," *IEEE Transactions on Circuits and Systems II (TCAS-II)*, 2013, h5-index: 37, [link](#)
- (11) Mohammad Hassan Ghaed, Gregory Chen, Razi-ul Haque, Michael Wieckowski, Yejoong Kim, Gyouho Kim, Yoonmyung Lee, Inhee Lee, David Fick, Daeyeon Kim, Mingoo Seok, Kensall, and K. Wise, David Blaauw, and Dennis Sylvester, "Circuits for a Cubic-Millimeter Energy-Autonomous Wireless Intraocular Pressure Monitor," *IEEE Transactions on Circuits and Systems I (TCAS-I)*, vol.60, no.12, pp.3152-3162, 2013, h5-index: 56, [link](#)
- (10) Matthew Fojtik, Daeyeon Kim, Gregory K. Chen, Yu-Shiang Lin, David Fick, Junsun Park, Mingoo Seok, Mao-Ter Chen, Zhiyoong Foo, David Blaauw, Dennis Sylvester, "Millimeter-Scale Energy-Autonomous Sensor System with Stacked Battery and Solar Cells," *IEEE Journal of Solid-State Circuits (JSSC)*, vol.48, no.3, pp.801-813, Mar. 2013, h5-index: 69, [link](#)

#### 2012

- (9) Dongsuk Jeon, Mingoo Seok, Zhengya Zhang, David Blaauw, Dennis Sylvester, "A Design Methodology for Voltage Overscaled Ultra-Low Power Systems," *IEEE Transactions on Circuits and Systems II (TCAS-II)*, vol.59, no.12, pp.952-956, Dec. 2012, h5-index: 37, [link](#)
- (8) Mingoo Seok, Gyouho Kim, David Blaauw, Dennis Sylvester, "A Portable 2-Transistor Picowatt Temperature-Compensated Voltage Reference Operating at 0.5V," *IEEE Journal of Solid-State Circuits (JSSC)*, vol.47, no.10, pp.2534-2545, Oct. 2012, h5-index: 69, [link](#)
- (7) Dongsuk Jeon, Mingoo Seok, Chaitali Chakrabarti, David Blaauw, Dennis Sylvester, "A Super-Pipelined Energy Efficient Subthreshold 240MS/s FFT Core in 65nm CMOS," *IEEE Journal of Solid-State Circuits (JSSC)*, vol.47, no.1, pp.23-34, 2012, invited for the special issue, h5-index: 69, [link](#)

#### 2011

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- (6) Mingoo Seok, David Blaauw, Dennis Sylvester, "Robust Clock Network Design Methodology for Ultra-Low Voltage Operations," *Journal on Emerging and Special Topics on Circuits and Systems (JETCAS)*, vol.1. no.2, pp.120-130, 2011, *invited*, h5-index: 26, [link](#)
  - (5) Mingoo Seok, Gregory Chen, Scott Hanson, Michael Wiecekowsky, David Blaauw, Dennis Sylvester, "Mitigating Variability in Near Threshold Computing," *Journal on Emerging and Special Topics on Circuits and Systems (JETCAS)*, vol.1. no.1, pp.42-49, 2011, *invited*, h5-index: 26, [link](#)
  - (4) Mingoo Seok, Scott Hanson, David Blaauw, Dennis Sylvester, "Sleep Mode Analysis and Optimization with Minimal-Sized Power Gating Switch for Ultra-low Vdd Operations," *Transactions on VLSI systems (TVLSI)*, vo.20. no.4, pp.605-615, 2011, h5-index: 44, [link](#)
- 2009**
- (3) Scott Hanson, Mingoo Seok, Yu-shiang Lin, Zhiyoong Foo, Daeyeon Kim, Yoonmyung Lee, Nurrachman Liu, Dennis Sylvester, David Blaauw, "A Low-Voltage Processor for Sensing Applications With Picowatt Standby Mode," *Journal of Solid State Circuits (JSSC)*, vol.44, no.4, pp.1145-1155, 2009, *invited*, h5-index: 69, [link](#)
- 2008**
- (2) Scott Hanson, Bo Zhai, Mingoo Seok, Brian Cline, Kevin Zhou, Meghna Singhal, Michael Minuth, Javin Olson, Leyla Nazhandali, Todd Austin, Dennis Sylvester, David Blaauw, "Exploring Variability and Performance in a Sub-200mV Processor," *Journal of Solid State Circuits (JSSC)*, vol.43, no.4, pp.881-891, Apr., 2008, *invited*, h5-index: 69, [link](#)
- 2007**
- (1) Scott Hanson, Mingoo Seok, Dennis Sylvester, David Blaauw, "Nanometer Device Scaling in Subthreshold Logic and SRAM," *Transactions on Electron Devices (TED)*, vol.55, no.1, pp.175-185, 2007, *invited*, h5-index: 59, [link](#)

#### Proceedings of Referred Conferences

**2019**

- (76) Joao P. Cerqueira, Thomas J. Repeti, Yu Pu, Shivam Priyadarshi, Martha A. Kim, Mingoo Seok, "Catena: A 0.5-V Sub-0.4-mW 16-Core Spatial Array Accelerator for Mobile and Embedded Computing," *IEEE Symposium on VLSI Circuits (VLSI)*, 2019, h5-index: 25
- (75) Sung Justin Kim, Dongkwun Kim, Yu Pu, Chunlei Shi, Mingoo Seok, "A 0.5-1V Input Event-Driven Multiple Digital Low-Dropout-Regulator System for Supporting a Large Digital Load," *IEEE Symposium on VLSI Circuits (VLSI)*, 2019, h5-index: 25
- (74) Weiwei Shan, Ao Fan, Jiaming Xu, Jun Yang, Mingoo Seok, "A 923Gbps/W, 113-Cycle, 2-Sbox Energy-efficient AES Accelerator in 28nm CMOS," *IEEE Symposium on VLSI Circuits (VLSI)*, 2019, h5-index: 25
- (73) Andrea Lottarini, Tom Repetti, Joao Pedro Cerqueira, Mingoo Seok, Kenneth A. Ross, Martha Kim, "Accelerate with Care: A Case Study of Over-Specialization," *ACM/IEEE International Conference on Computer Architecture (ISCA)*, 2019, h5-index: 50
- (72) Zhewei Jiang, Shihui Yin, Jae-sun Seo, Mingoo Seok, "XNOR-SRAM: In-Bitcell Computing SRAM Macro based on the Resistive Computing Mechanism," *ACM Great Lakes Symposium on VLSI (GLSVLSI)*, 2019, *invited*, h5-index: 16

- (71) Mingoo Seok, Minhao Yang, Zhewei Jiang, Aurel. A. Lazar, Jae-sun Seo, "Cases for Analog-Mixed-Signal Computing Integrated-Circuits for Deep Neural Networks," *International Symposium on VLSI Design, Automation, and Test (VLSI-DAT)*, 2019, invited, h5-index: 10  
**2018**
- (70) Yipeng Huang, Ning Guo, Simha Sethumadhavan, Mingoo Seok, Yannis Tsividis, "A Case Study in Analog Co-Processing for Solving Stochastic Differential Equations," *IEEE International Conference on Digital Signal Processing (DSP)*, 2018, h5-index: 18
- (69) Pavan Kumar Chundi, Ajay Kumar Sridhar, Saarthak Sarup, Mingoo Seok, "High-Capacity Fingerprint Recognition System based on a Dynamic Memory-Capacity Estimation Technique," *IEEE Biomedical Circuits and Systems Conference*, 2018, invited to the special session, h5-index: 14, preprint is uploaded at [Arxiv](#)
- (68) Jiangyi Li, Pavan Kumar Chundi, Sung Justin Kim, Zhewei Jiang, Minhao Yang, Joonseong Kang, Seungchul Jung, Sang Joon Kim, Mingoo Seok, "A 0.78- $\mu$ W 96-Ch. Neural Signal Processor Integrated with a Nanowatt Power Management Unit based on Energy-Robustness Co-Optimization Control," *IEEE European Solid-State Circuits Conference (ESSCIRC)*, 2018 h5-index: 22
- (67) Sheng Zhang, Adrian Tang, Zhewei Jiang, Simha Sethumadhavan, Mingoo Seok, "Blacklist Core: Machine-Learning Based Dynamic Operating-Performance-Point Blacklisting for Mitigating Power-Management Security Attacks," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, 2018, h5-index: 24
- (66) Dongkwun Kim, Mingoo Seok, "Better-Than-Worst-Case Design Methodology for a Compact Integrated Switched-Capacitor DC-DC Converter," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, 2018, h5-index: 24
- (65) Zhewei Jiang, Shihui Yin, Mingoo Seok, Jae-Sun Seo, "XNOR-SRAM: In-Memory Mixed-Signal Accelerator for Binary/Ternary-Input and Binary-Weight Deep Neural Networks," *IEEE Symposium on VLSI Technology (VLSIT)*, 2018, h5-index: 32
- (64) Doyun Kim, Sung Justin Kim, Jonghwan Kim, Hyunju Ham, Mingoo Seok, "0.5V- $V_{IN}$ , 165- $\text{mA}/\text{mm}^2$  Fully-Integrated Digital LDO based on Event-Driven Self-Triggering Control," *IEEE Symposium on VLSI Circuits (VLSIC)*, 2018, h5-index: 25
- (63) Mingoo Seok, Peter R. Kinget, Teng Yang, Jiangyi Li, Doyun Kim, "Recent Advances in *In-situ* and *In-field* Transistor-Aging Monitoring and Compensation Techniques," *IEEE International Reliability Physics Symposium (IRPS)*, 2018, invited, h5-index: 25
- (62) Minhao Yang, Chung-Heng Yeh, Yiyin Zhou, Joao Pedro Cerqueira, Aurel Lazar, Mingoo Seok, "1- $\mu$ W Voice Activity Detector using Analog Feature Extraction and Digital Deep Neural Network," *IEEE International Solid-State Circuits Conference (ISSCC)*, 2018, h5-index: 57  
**2017**
- (61) Yipeng Huang, Ning Guo, Mingoo Seok, Yannis Tsividis, Kyle Mandli, Simha Sethumadhavan, "Hybrid Analog-Digital Accelerator for Differential and Algebraic Equations," *IEEE International Conference on Rebooting Computing (ICRC)*, 2017, h5-index: NA
- (60) Tom Repetti, Joao Pedro Cerqueira, Martha Kim, Mingoo Seok, "Pipelining a Triggered Processing Element," *IEEE/ACM Symposium on Microarchitecture (Micro)*, 2017, h5-index: 41
- (59) Yipeng Huang, Ning Guo, Kyle T. Mandli, Mingoo Seok, Yannis Tsividis, Simha Sethumadhavan, "Hybrid Analog-Digital Solution of Nonlinear Partial Differential Equations," *IEEE/ACM*

- Symposium on Microarchitecture (Micro)*, 2017, **Honorable Mention, Top Picks from the Computer Architecture Conferences**, h5-index: 41
- (58) Joao Pedro Cerqueira, Mingoo Seok, "0.17mm<sup>2</sup> 3.19nJ/Transform 256-pt FFT Processor based on Spatiotemporal Active Leakage Suppression Techniques," *European Solid-State Circuits Conference (ESSCIRC)*, 2017, h5-index: 22
- (57) Seongjong Kim, Joao Pedro Cerqueira, Mingoo Seok, "Ultra-Low-Power and Robust Power-Management/Microprocessor System Using Digital Error-based Regulation," *European Solid-State Circuits Conference (ESSCIRC)*, 2017, h5-index: 22
- (56) Pavan Kumar Chundi, Yini Zhou, Martha Kim, Eren Kursun, Mingoo Seok, "Evaluation of Miniature Temperature Sensors on On-Chip Hotspot Monitoring," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, 2017, h5-index: 24
- (55) Sung Kim, Doyun Kim, Mingoo Seok, "Comparative Study and Optimization of Synchronous and Asynchronous Comparators at Near-threshold Voltages," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, 2017, h5-index: 24
- (54) Teng Yang, Pavan Chundi, Seongjong Kim, Eren Kursun, Martha Kim, Peter R. Kinget, Mingoo Seok, "Compact and Voltage-Scalable Sensor for Accurate Thermal Sensing in Dynamic Thermal Management," *IEEE International Midwest Symposium on Circuits and Systems (MWSCAS)*, 2017, *invited*, h5-index: 17
- (53) Jiangyi Li, Teng Yang, Mingoo Seok, "A Technique to Transform 6T-SRAM Arrays into Robust Analog PUF with Minimal Overhead," *IEEE International Symposium on Circuits & Systems (ISCAS)*, 2017, h5-index: 27
- (52) Teng Yang, Jiangyi Li, Minhao Yang, Peter R. Kinget, Mingoo Seok, "An Area-Efficient Microprocessor-SoC with an Instruction-Cache Transformable to a Temperature Sensor and a Physically Unclonable Function," *IEEE Custom Integrated Circuits Conference (CICC)*, 2017, h5-index: 22
- (51) Zhewei Jiang, Chisung Bae, Joonseong Kang, Sang Joon kim, Mingoo Seok, "Microwatt End-to-End Digital Neural Signal Processing Systems for Motor Intention Decoding," *Design, Automation, and Test in Europe (DATE)*, 2017, h5-index: 43
- (50) Tianchan Guan, Xiaoyang Zeng, Mingoo Seok, "Extending Memory Capacity of Neural Associative Memory based on Recursive Synaptic Bit Reuse," *Design, Automation, and Test in Europe (DATE)*, 2017, h5-index: 43
- (49) Doyun Kim, Jonghwan Kim, Hyunju Ham, Mingoo Seok, "A 0.5V- $V_{IN}$  1.44mA-Class Event-Driven Digital LDO with a Fully-Integrated 100pF Output Capacitor," *IEEE International Solid-State Circuits Conference (ISSCC)*, 2017, h5-index: 57
- 2016**
- (48) Wei Jin, Seongjong Kim, Weifeng He, Zhigang Mao, Mingoo Seok, "A 0.35V 1.3pJ/Cycle 20MHz 8-Bit 8-Tap FIR Core Based on Wide-Pulsed-Latch Pipelines," *IEEE Asian Solid-State Circuits Conference (ASSCC)*, 2016, h5-index: 14
- (47) Jiangyi Li, Jae-Sun Seo, Ioannis Kymissis, Mingoo Seok, "Triple-Mode Photovoltaic Power Management: Achieving High Efficiency against Harvesting and Load Variability," *IEEE Asian Solid-State Circuits Conference (ASSCC)*, 2016, h5-index: 14

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- (46) Tianchan Guan, Letian Huang, Xiaoyang Zeng, Mingoo Seok, "Neural Network based Seizure Detection System using Raw EEG Data," *International SoC Design Conference (ISOCC)*, 2016, *invited for the special session*
- (45) Teng Yang, Peter R. Kinget, Mingoo Seok, "Register File Circuits and Post-Deployment Framework to Monitor Aging Effects *in Field*," *European Solid-State Circuits Conference (ESS-CIRC)*, 2016, h5-index: 22, [link](#)
- (44) Seongjong Kim, Joao Pedro Cerqueira, Mingoo Seok, "A 450mV Timing-Margin-Free Waveform Sorter based on Body Swapping Error Correction," *IEEE Symposium on VLSI Circuits (VLSI)*, 2016, h5-index: 25, [link](#)
- (43) Zhewei Jiang, Joao Pedro Cerqueira, Seongjong Kim, Qi Wang, Mingoo Seok, "1.74- $\mu$ W/ch, 95.3%-Accurate Spike-Sorting Hardware based on Bayesian Decision" *IEEE Symposium on VLSI Circuits (VLSI)*, 2016, h5-index: 25, [link](#)
- (42) Yipeng Huang, Ning Guo, Mingoo Seok, Yannis Tsvividis, Simha Sethumadhavan, "Evaluation of an Analog Accelerator," *ACM/IEEE International Symposium on Computer Architecture (ISCA)*, 2016, *Top Pick in 2016*, h5-index: 50, [link](#)
- (41) Doyun Kim, Mingoo Seok, "Fully-Integrated Low Drop-Out Regulator based on Event-Driven PI Control," *IEEE International Solid-State Circuits Conference (ISSCC)*, 2016, h5-index: 57, [link](#)

#### 2015

- (40) Jae-Sun Seo, Mingoo Seok, "Digital CMOS Neuromorphic Processor Design Featuring Unsupervised Online Learning," *IEEE/IFIP International Conference on VLSI and System-on-Chip (VLSI-SoC)*, 2015, *invited*, [link](#)
- (39) Doyun Kim, Jiangyi Li, Mingoo Seok, "Energy-Optimal Voltage Model Supporting a Wide Range of Nodal Switching Rates for Early Design-Space Exploration," *IEEE International Conference on Computer Design (ICCD)*, 2015, h5-index: 19, [link](#)
- (38) Seongjong Kim, Mingoo Seok, "A 30.1 $\mu$ m<sup>2</sup>,  $\pm$ 1.1 $^{\circ}$ C-3 $\sigma$ -Error, 0.4-to-1.0V Temperature Sensor based on Direct Threshold-Voltage Sensing for Dense On-Chip Thermal Monitoring," *IEEE Custom Integrated Circuits Conference (CICC)*, 2015, h5-index: 22, [link](#)
- (37) Ning Guo, Yipeng Huang, Tao Mai, Shavil Patil, Chi Cao, Mingoo Seok, Simha Sethumadhavan, Yannis Tsvividis, "Continuous-Time Hybrid Computation with Programmable Nonlinearities," *European Solid-State Circuits Conference (ESSCIRC)*, 2015, h5-index: 22, [link](#)
- (36) Beinuo Zhang, Zhewei Jiang, Qi Wang, Jae-Sun Seo, Mingoo Seok, "A Neuromorphic Neural Spike Clustering Processor for Deep-Brain Sensing and Stimulation Systems," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, 2015 h5-index: 24, [link](#)
- (35) Jiangyi Li and Mingoo Seok, "A 3.07 $\mu$ m<sup>2</sup>/bitcell Physically Unclonable Function with 3.5% and 1% Bit-Instability across 0 to 80 $^{\circ}$ C and 0.6 to 1.2V in a 65nm CMOS," *IEEE Symposium on VLSI Circuits (VLSI)*, 2015, h5-index: 25, [link](#)
- (34) Zhewei Jiang, Qi Wang, Mingoo Seok, "A Low Power Unsupervised Spike Sorting Accelerator Insensitive to Clustering Initialization in Sub-optimal Feature Space," *ACM/EDAC/IEEE Design Automation Conference (DAC)*, 2015, h5-index: 46, [link](#)



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- (33) Fabio Carta, Htay Hlaing, Hassan Edrees, Shyuan Yang, Mingoo Seok, Ioannis Kymissis, "Co-Development of Complementary Technology and Modified-CPL Family for Organic Digital Integrated Circuits," *Material Research Society Proceedings*, vol.1795, 2015, [link](#)
- (32) Teng Yang, Doyun Kim, Peter R. Kinget, Mingoo Seok, "In-situ Techniques for In-field Sensing of NBTI Degradation in an SRAM Register File," *IEEE International Solid-State Circuits Conference (ISSCC)*, 2015, h5-index: 57, [link](#)
- 2014**
- (31) Seongjong Kim, Mingoo Seok, "Analysis and Optimization of In-Situ Error Detection Techniques in Ultra-Low-Voltage Pipeline," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, 2014, h5-index: 24, [link](#)
- (30) Seongjong Kim, Mingoo Seok, "Reconfigurable Interconnect-Driving Technique for Ultra-Dynamic-Voltage-Scaling Systems," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, 2014, h5-index: 24, [link](#)
- (29) Seongjong Kim, Mingoo Seok, "R-Processor: 0.4V Resilient Processor with a Voltage-Scalable and Low-Overhead In-Situ Error Detection and Correction Technique in 65nm CMOS," *IEEE Symposium on VLSI Circuits (VLSI)*, 2014, h5-index: 25, [link](#)
- (28) Jiangyi Li, Mingoo Seok, "Robust and In-Situ Self-Testing Technique for Monitoring Device Aging Effects in Pipeline Circuits," *ACM/EDAC/IEEE Design Automation Conference (DAC)*, 2014, h5-index: 46, [link](#)
- (27) Teng Yang, Seongjong Kim, Peter R. Kinget, Mingoo Seok, "0.6-1.0V,  $279\mu m^2$ ,  $0.92\mu W$  Temperature Sensor with  $< +3.2/-3.4^\circ C$  Error for Dense On-Chip Thermal Monitoring," *IEEE International Solid-State Circuits Conference (ISSCC)*, pp.282-283, 2014, h5-index: 57, [link](#)
- 2013**
- (26) Mingoo Seok, Zhe Cao, "Parallelism and Pipelining in Ultra-Low Voltage Digital Circuits," *IEEE SOI-3D-Subthreshold Microelectronics Technology Unified Conference (S3S)*, 2013, *invited*, h5-index: 9[link](#)
- (25) Yu Chen, Mingoo Seok, Steve M. Nowick, "Robust and Energy-Efficient Asynchronous Dynamic Pipelines for Ultra-Low-Voltage Operations Using Adaptive Keeper Control," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, pp.267-272, 2013, h5-index: 24, [link](#)
- (24) Jian Liu, Steve M. Nowick, Mingoo Seok, "Soft MOUSETRAP: a Bundled-Data Asynchronous Pipeline Scheme Tolerant to Random Variations at Ultra Low Supply Voltages," *IEEE International Symposium on Asynchronous Circuits and Systems (ASYNC)*, pp.1-7, 2013, [link](#)
- 2012**
- (23) Mingoo Seok, "Performance and Energy-Efficiency Improvement through Modified CPL in Organic Transistor Integrated Circuits," *ACM/IEEE International Symposium on Low Power Electronics and Designs (ISLPED)*, pp. 215-220, 2012, h5-index: 24, [link](#)
- (22) Mingoo Seok, "A Fine-Grained Many VT Design Methodology for Ultra Low Voltage Operations," *ACM/IEEE International Symposium on Low Power Electronics and Designs (ISLPED)*, pp. 161-166, 2012, h5-index: 24, [link](#)
- (21) Mingoo Seok, "Decoupling Capacitor Design Strategy for Minimizing Supply Noise of Ultra Low Voltage Circuits," *ACM/EDAC/IEEE Design Automation Conference (DAC)*, pp. 968-973, 2012, h5-index: 46, [link](#)

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- (20) Mingoo Seok, Dongsuk Jeon, Chaitali Chakrabarti, David Blaauw, Dennis Sylvester, "Extending Energy-Saving Voltage Scaling in Ultra Low Voltage Integrated Circuit Designs," *International Conference on IC Design and Technology (ICICDT)*, pp.1-4, 2012, invited, h5-index: 9, [link](#)
- 2011**
- (19) Mingoo Seok, Dongsuk Jeon, Chaitali Chakrabarti, David Blaauw, Dennis Sylvester, "A 0.27V, 30MHz, 17.7nJ/transform 1024-pt Complex FFT Core with super-pipelining," *International Solid-State Circuits Conferences (ISSCC)*, pp. 342-344, 2011, h5-index: 57, [link](#)
- (18) Gregory Chen, Hassan Ghaed, Razi-UI Haque, Michael Wieckowski, Yejoong Kim, Gyouho Kim, David Fick, Daeyeon Kim, Mingoo Seok, Kensall Wise, David Blaauw, Dennis Sylvester, "A 1 Cubic Millimeter Energy-Autonomous Wireless Intraocular Pressure Monitor," *International Solid-State Circuits Conferences (ISSCC)*, pp.310-312, 2011, h5-index: 57, [link](#)
- (17) Mingoo Seok, Dongsuk Jeon, Chaitali Chakrabarti, David Blaauw, Dennis Sylvester, "Pipeline Strategy for Improving Optimal Energy Efficiency in Ultra-Low Voltage Design" *ACM/IEEE Design Automation Conference (DAC)*, pp.990-995, 2011, h5-index: 46, [link](#)
- (16) Dongsuk Jeon, Mingoo Seok, Chaitali Chakrabarti, David Blaauw, Dennis Sylvester, "Energy-Optimized High Performance FFT Processor," *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, pp.1701-1704, 2011, h5-index: 61, [link](#)
- (15) Daeyeon Kim, Gregory K. Chen, Matthew Fojtik, Mingoo Seok, Dennis Sylvester, David Blaauw, "A Femtowatt-Scale Ultra-Low Leakage 10T SRAM with Speed Compensation Scheme," *International Symposium on Circuits and Systems (ISCAS)*, pp.69-72, 2011, h5-index: 27, [link](#)
- 2010**
- (14) Mingoo Seok, Gyouho Kim, David Blaauw, Dennis Sylvester, "Variability Analysis of a Digitally Trimmable Ultra-Low Power Voltage Reference," *European Solid-State Circuits Conference (ESSCIRC)*, pp.110-113, Sep, 2010, h5-index: 22, [link](#)
- (13) Mingoo Seok, David Blaauw, Dennis Sylvester, "Clock Network Design for Ultra-Low Power Applications," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, pp.271-276, Aug, 2010, h5-index: 24, [link](#)
- (12) Mingoo Seok, Scott Hanson, Michael Wieckowski, Gregory K. Chen, Yu-Shiang Lin, David Blaauw, Dennis Sylvester, "Circuit Design Advances to Enable Ubiquitous Sensing Environments," *International Symposium on Circuits and Systems (ISCAS)*, pp.285-288, 2010, invited, h5-index: 27, [link](#)
- (11) Gregory K. Chen, Matthew Fojtik, Daeyeon Kim, David Fick, Junsun Park, Mingoo Seok, Mao-Ter Chen, Zhiyong Foo, Dennis Sylvester, David Blaauw, "A Millimeter-Scale Nearly-Perpetual Sensor System with Stacked Battery and Solar Cells," *International Solid-State Circuits Conference (ISSCC)*, pp.288-289, 2010, h5-index: 57, [link](#)
- 2009**
- (10) Mingoo Seok, Gyouho Kim, Dennis Sylvester, David Blaauw, "A 0.5V 2.2pW 2-Transistor Voltage Reference," *Custom Integrated Circuit Conference (CICC)*, pp.577-580, 2009, h5-index: 22, [link](#)

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- (9) Michael Wieckowski, Gregory K. Chen, Mingoo Seok, Dennis Sylvester, David Blaauw, "A Hybrid DC-DC Converter for Nanoampere Sub-1V Implantable Applications," *IEEE Symposium on VLSI Circuits (VLSI)*, pp.166-167, 2009, h5-index: 25, [link](#)  
**2008**
- (8) Dennis Sylvester, Scott Hanson, Mingoo Seok, Yu-Shiang Lin, David Blaauw, "Designing Robust Ultra-Low Power Circuits," *International Electron Device Meetings (IEDM)*, pp.1 2008, *invited*, h5-index: 42, [link](#)
- (7) Mingoo Seok, Scott Hanson, Jae-sun Seo, Dennis Sylvester, David Blaauw "Robust Ultra-low Voltage ROM Design," *Custom Integrated Circuit Conference (CICC)*, pp.423-426, 2008, h5-index: 22, [link](#)
- (6) Yoonmyung Lee, Mingoo Seok, Scott Hanson, David Blaauw, Dennis Sylvester "Standby Power Reduction Techniques for Ultra-Low Power Processors," *European Solid-State Circuits Conference (ESSCIRC)*, pp.186-189, 2008, h5-index: 22, [link](#)
- (5) Mingoo Seok, Dennis Sylvester, David Blaauw, "Optimal Technology Selection for Minimizing Energy and Variability in Low Voltage Applications," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)* , pp.9-14, 2008, h5-index: 24, [link](#)
- (4) Mingoo Seok, Scott Hanson, Yu-Shiang Lin, Zhiyoong Foo, Daeyeon Kim, Yoonmyung Lee, Nurrachman Liu, Dennis Sylvester, David Blaauw, "The Phoenix Processor: A 30pW Platform for Sensor Applications," *IEEE Symposium on VLSI Circuits (VLSI)*, pp.188-189, 2008, h5-index: 25, [link](#)  
**2007**
- (3) Mingoo Seok, Scott Hanson, Dennis Sylvester, David Blaauw, "Analysis and Optimization of Sleep modes in Subthreshold Circuit Design," *ACM/IEEE Design Automation Conference (DAC)*, pp.694-699, 2007, h5-index: 46, [link](#)
- (2) Scott Hanson, Mingoo Seok, David Blaauw, Dennis Sylvester, "Nanometer Device Scaling in Subthreshold Circuits," *ACM/IEEE Design Automation Conference (DAC)*, pp.700-705, 2007, h5-index: 46, [link](#)
- (1) Scott Hanson, Bo Zhai, Mingoo Seok, Brian Cline, Kevin Zhou, Meghna Singhal, Michael Minuth, Javin Olson, Leyla Nazhandali, Todd Austin, Dennis Sylvester, David Blaauw, "Performance and Variability Optimization Strategies in a 150mV processor," *IEEE Symposium on VLSI Circuits (VLSI)*, pp.152-153, 2007, h5-index: 25, [link](#)

#### Other Non-Referred Publications

- (15) Peiye Liu, Wu Liu, Huadong Ma, Tao Mei, Mingoo Seok, "KTAN: Knowledge Transfer Adversarial Network," arXiv.org, 2018, [link](#)
- (14) Dongkwun Kim, Suyoung Bang, Minki Cho, Seongjong Kim, Suhwan Kim, Ram Kumar Krishnamurthy, Mingoo Seok, "Better-Than-Worst-Case Design Methodology for a Compact Integrated Switched-Capacitor DC-DC Converter," SRC TECHCON, Aug, 2018
- (13) Guanshun Yu, Tom Cheng, Blayne Kettlewell, Harrison Liew, Mingoo Seok, Peter R. Kinget, "An FPGA Architecture and Chip-Prototype based on Open-Source VTR CAD Flow," Arxiv.org, 2017, [link](#)

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- (12) Zhewei Jiang, Shuhui Yin, Mingoo Seok, Jae-sun Seo, "XNOR-SRAM: In-Memory Mixed-Signal Accelerator for Binary/Ternary-Input and Binary-Weight Deep Neural Networks," *Presentation at the 2018 ISSCC Student Research Preview (SRP) (Student work in progress)*, Feb., 2018
- (11) Yipeng Huang, Ning Guo, Mingoo Seok, Yannis Tsividis, Kyle Mandli, Simha Sethumadhavan, "Hybrid Analog-Digital Solution of Nonlinear Partial Differential Equations," *Heidelberg Laureate Forum, Heidelberg University*, Sep. 2017
- (10) Mingoo Seok, Minhao Yang, Zhewei Jiang, Tianchan Guan, "Machine Learning with Constrained Resources," *IBM / IEEE CAS EDS Symposium*, Sep. 2017
- (9) Yipeng Huang, Ning Guo, Kyle Mandli, Mingoo Seok, Yannis Tsividis, Simha Sethumadhavan, "Hybrid Analog-Digital Solution of Nonlinear Partial Differential Equations," *Data Science Day @ Columbia University*, Apr., 2017
- (8) Yipeng Huang, Ning Guo, Mingoo Seok, Yannis Tsividis, Simha Sethumadhavan, "Hybrid Analog-Digital Computing for Solving Nonlinear Systems," *Frontiers in Computing Systems Symposium, Columbia University*, March 2017
- (7) Yipeng Huang, Ning Guo, Mingoo Seok, Yannis Tsividis, Simha Sethumadhavan, "Hybrid Analog-Digital Computation for Solving Non-Linear Systems," *Data Science Day @ Columbia University*, Apr., 2016
- (6) Seongjong Kim, Joao Pedro Cerqueira, Mingoo Seok, "A 450mV Timing-Margin-Free Unsupervised Sorter based on Spiking Neural Network," *Data Science Day @ Columbia University*, Apr., 2016
- (5) Seongjong Kim, Joao Pedro Cerqueira, Mingoo Seok, "Variation Adaptive Digital Circuit Design," *Presentation at the 2016 ISSCC Student Research Preview (SRP) (Student work in progress)*, Jan., 2016
- (4) Zhewei Jiang, Mingoo Seok, "A Low Power Unsupervised Spike Sorting Accelerator Insensitive to Clustering Initialization in Sub-Optimal Feature Space," *Data on a Mission, Internet of Things, A Mini-Symposium with Industry Experts, Columbia University*, May, 2015
- (3) Seongjong Kim, Mingoo Seok, "R-Processor: Resilient Microprocessor Design for Ultra-Low-Power Ubiquitous Computing," *Data on a Mission, Internet of Things, A Mini-Symposium with Industry Experts, Columbia University*, May, 2015
- (2) Paolo Mantovani, Emilion G. Cota, Seongjong Kim, Kevin Tien, Johnnie Chan, Giuseppe Di Guglielmo, Christian Pilato, Martha A. Kim, Mingoo Seok, Kenneth Shepard, Luca P. Carloni, "Benchmarking Methodology for Embedded Scalable Platforms," *SEAK: DAC Workshop on Suite of Embedded Applications and Kernels during ACM/EDAC/IEEE Design Automation Conference*, 2014
- (1) Mingoo Seok, Scott Hanson, Yu-Shiang Lin, Zhiyoong Foo, Daeyeon Kim, Yoonmyung Lee, Nurrachman Liu, Dennis Sylvester, David Blaauw, "Phoenix: an Ultra-Low Power Processor for Cubic Millimeter Sensor Systems," *ACM/IEEE Design Automation Conference (DAC)*, 2009 [DAC/ISSCC Student Design Contest Winner], [link](#)

## Patents

Patents. Issued: 6; filed: 6; provisional filed: 0

Seok, Mingoo

- (12) Jae-sun Seo, Shihui Yin, Zhewei Jiang, Mingoo Seok, "Static Random-Access Memory for Deep Neural Networks," US20190087719A1, 2019
- (11) Hyun-Ju Ham, Jong-Hwan Kim, Mingoo Seok, Doyun Kim, Sung Justin Kim, "Digital Low Drop-Out Regulator and Operation Method thereof," US Patent 10216209, 2019
- (10) Sung Kim, Doyun Kim, Mingoo Seok, Hyun-Ju Ham, Jong-Hwan Kim, "Digital Low Drop-Out Regulator," US and S. Korea patent filed, 2018
- (9) Mingoo Seok, Zhewei Jiang, Shihui Yin, Jae-Sun Seo, "SRAM Design with Embedded XNOR Functionality for Binary and Ternary Neural Networks," US patent filed, 2017
- (8) Doyun Kim, Mingoo Seok, Hyun-Ju Ham, Jong-Hwan Kim, "Digital Low Drop-Out Regulator," US and S. Korea patent filed, 2017
- (7) Doyun Kim, Mingoo Seok, Hyun-Ju Ham, Jong-Hwan Kim, "Digital Low Drop-Out Regulator," US and S. Korea patent filed, 2017
- (6) Mingoo Seok, Peter Kinget, Teng Yang, "Circuits, Methods, and Media For Detecting and Countering Aging Degradation in Memory Cells," US Patent 9,424,952, 2016
- (5) Seongjong Kim, Mingoo Seok, "Circuits for temperature monitoring," US 20160265981 A1, 2015
- (4) Mingoo Seok, Jiangyi Li, "Voltage and temperature compensated device for physically unclonable function," US 20160337123 A1, 2015
- (3) Mingoo Seok, Peter Kinget, Teng Yang, Seongjong Kim, "Circuits for temperature sensors," WO 2015066629 A1, 2014
- (2) Mingoo Seok, Jing-Fei Ren, Manish Goel, "Security of Cryptographic Devices Against Differential Power Analysis," US2013191652(A1), US8782446(B2), WO2013110055(A1), WO2013110055(A8)
- (1) Mingoo Seok, Dennis Sylvester, David Blaauw, Scott Hanson Gregory K. Chen, "Pico-power Reference Voltage Generator," US2010327842(A1) US8564275(B2) WO2010151754(A2) WO2010151754(A3) TW201116968(A), KR20120132459 (A), JP2012531825(A), EP2446337(A2), CN102483634(A), *commercially licensed*

#### Invention Disclosures

- (3) Yannis Tsvividis, Ning Guo, Mingoo Seok, "A Continuous-Time Apparatus for Generating Analog Look-up Tables and Generating Analog Nonlinear Functions," Disclosure filed, 2013
- (2) Mingoo Seok, Yoonmyung Lee, Scott Hanson, David Blaauw, Dennis Sylvester, "Low leakage memory circuit," Disclosure filed, UM file number 3760
- (1) Mingoo Seok, Scott Hanson, Jae-sun Seo, David Blaauw, Dennis Sylvester, "Robust low voltage read-only memory," Disclosure filed, UM file number 4159

#### Invited Lectures

- (61) Maryland College Park Circuit and Systems (CAS) Chapter, "Ultra-Low-Power Computing Hardware Design in the Era of AI and ML," May., 2019
- (60) International Symposium on VLSI Design, Automation, and Test (VLSI-DAT), Special Session, Cases for Analog Mixed Signal Computing for Deep Neural Networks, Hsinchu, Taiwan, Apr, 2019

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- (59) Cornell University, EDS Seminar Series, "Ultra-Low-Power Computing Hardware Design in the Era of AI and ML," Mar., 2019
- (58) Northeast Regional Conference, "Recent Advances in AI and ML Hardware Design," Mar., 2019
- (57) University of California Berkeley, Berkeley Wireless Research Center (BWRC) Seminar Series "Ultra-Low-Power Computing Hardware Design in the Era of AI and ML," Mar., 2019
- (56) Apple, "Recent Advances in AI and ML Hardware Design," Mar., 2019
- (55) Columbia DSI/TRIPODS Deep Learning Workshop, "Recent Advances in AI and ML Hardware Design," Mar., 2019
- (54) International Conference on Computer-Aided Design (ICCAD), Special Session, Introduction of the recent advances on analog-mixed-signal circuit design automation, San Diego, CA, USA, Nov., 2018
- (53) University of Minnesota, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," Oct., 2018
- (52) Oregon State University, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," Oct., 2018
- (51) Stanford University, SystemX/EE310, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," Oct., 2018
- (50) KFAS Workshop for Young Scientists, Seoul, Republic of Korea, "Tips for Solid-State Circuits Research," August, 2018
- (49) **TEDxKFAS**, Seoul, Republic of Korea, "The Future of AI is Small," August, 2018, > 1,000 participants, [webpage](#), [press](#), [video](#)
- (48) Scientific Innovtion, Icheon Sub Forum, Seoul, Republic of Korea, "The Future of AI is Small," August, 2018
- (47) Intel CRL, Hillsboro, OR, USA, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," July, 2018
- (46) Huawei, Shanghai, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," July, 2018
- (45) Southeast University, Nanjing, China, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," July, 2018
- (44) Fudan University, Shanghai, China, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," July, 2018
- (43) Shanghai Jiao Tong University, Shanghai, China, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," July, 2018
- (42) SK Hynix, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," May, 2018
- (41) Samsung LSI, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," May, 2018
- (40) Samsung SAIT Analog Circuit Workshop, "The Roles of Analog and Mixed-Signal Circuits in AI and ML Hardware," May, 2018
- (39) California Institute of Technology, Electrical Engineering Seminar Series, "Toward Ultra-Low-Power Computing in the Era of Artificial Intelligence," Apr., 2018

- (38) IBM TJ Watson Research Center, "Machine Learning with Less Resources," Apr., 2018
- (37) Qualcomm, "Recent Advances in Ultra-Low-Power VLSI Circuits: ," Apr., 2018
- (36) IEEE Custom Integrated Circuits Conference (CICC), Panel, What Can/Should Analog Circuit Designers Do to Ride on the Wave of Machine Learning? A panelist with Boris Murmann (Stanford), Edgar Sanchez-Sinencio (TAMU), Vivek De (Intel), San Diego CA, USA, Apr., 2018
- (35) SK Hynix, Frontier Research Lab, "In-Memory Computing Hardware for Deep Neural Networks," Dec. 18, 2017
- (34) SK Hynix, "Fully-Integrated Low-Drop-Out Regulator Design based on Event-Driven Control," Dec. 18, 2017
- (33) Seoul National University, "Fully-Integrated Low-Drop-Out Regulator Design based on Event-Driven Control," Dec. 15, 2017
- (32) Samsung SAIT, "Internet of Things X Machine Learning," Dec. 14, 2017
- (31) Samsung SAIT, "On-Chip Processing and Machine-Learning for a Nanowatt Brain-Computer-Interface Implant," Dec. 14, 2017
- (30) Silicon Labs, "Tackling Variability and Leakage Challenges in Designing a Microwatt Near-Threshold Digital Processor", Dec. 9, 2017
- (29) Data Science Institute, Sensing, Collecting, and Moving Data Center (SCM), "Internet of Things X Machine Learning," Oct., 2017
- (28) University of Michigan at Ann Arbor, "IoT Sensing Devices X Machine Learning," Sep., 2017
- (27) ARM Research Summit, Cambridge, England, "IoT Sensing Devices X Machine Learning," Sep., 2017
- (26) NE-Ohio Regional Workshop on Community Infrastructure for Analog Circuit Design, Case Western Reserve University, "Analog Computing for the 21-st Century," Aug., 2017, *keynote talk*
- (25) MIT, "IoT Sensing Devices X Machine Learning," Aug., 2017
- (24) Northeastern University, "IoT Sensing Devices X Machine Learning," Aug., 2017
- (23) ARM Research Lab at Austin, "Challenges and Opportunities in VLSI Design at the End of Moore's Law", May. 2017
- (22) Data Science Day, Lightning Session II: Applications of Data Science, "Computational Principles of Biological Memory: from Models to VLSI Neuromorphic Systems," with Prof. Stefano Fusi (Neuroscience), Apr. 5, 2017
- (21) Indian Institute of Technology at Madras (IIT Madras), "Fully Integrated Low-Drop-Out Regulator Based on Event-Driven Control," Jan. 2017
- (20) Korea Advanced Institute of Science and Technology, Daejeon, "Challenges and Opportunities in VLSI Design at the End of Moore's Law", Aug. 2016
- (19) Yeonsei University, Seoul, "Challenges and Opportunities in VLSI Design at the End of Moore's Law", Aug. 2016
- (18) SK Hynix Frontier Lab, Icheon, "IoT × Machine Learning," Aug. 2016
- (17) SK Hynix, "Fully-Integrated Digital Low-Dropout Regulator Design based on Novel Event-Driven Control Systems," Jun., 2016

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- (16) Samsung SAIT, "Challenges and Opportunities in VLSI Design at the End of Moore's Law," Jun., 2016
- (15) SK Hynix, "Challenges and Opportunities in VLSI Design at the End of Moore's Law," Jun., 2016
- (14) University of California Irvine, Design for Adaptivity: Tackling Variability Challenges in VLSI Circuits, Apr., 2016
- (13) Korea Institute of Energy Technology Evaluation and Planning, Ultra-Low-Energy Microsystems for the Internet of Things Era, Nov., 2015
- (12) Intel, Circuit Research Lab, Hillsboro OR, Tackling Variability Challenge in VLSI Circuits, Apr. 2015
- (11) University of Texas, Austin TX, Tackling Variability Challenge in VLSI Circuits, Jan. 2015
- (10) **International Symposium on New Frontiers in Scientific Innovation** (Organized by Korea Foundation of Advanced Studies (KFAS) and Chosun Ilbo), Seoul, Energy-Efficient Integrated Circuits and Systems for Emerging Applications, Jul. 2014, *more than 5,000 RSVPs*
- (9) Seoul National University, Seoul, Advances in Energy-Efficient and Variation-Tolerant Integrated Circuits & Systems Design, Jul. 2014
- (8) Korea Advanced Institute of Science and Technology, Daejeon, Advances in Energy-Efficient and Variation-Tolerant Integrated Circuits & Systems Design, Jul. 2014
- (7) Samsung Electronics, System LSI, Hwaseong, Advances in Energy-Efficient and Variation-Tolerant Integrated Circuits & Systems Design, Jul. 2014
- (6) SK Hynix, Icheon, Advances in Energy-Efficient and Variation-Tolerant Integrated Circuits & Systems Design, Jul. 2014
- (5) IEEE SOI-3D-Subthreshold Microelectronics Technology Unified Conference (S3S), Monterey CA, "Parallelism and Pipelining in Ultra-Low Voltage Digital Circuits," Oct. 2013
- (4) International Conference on IC Design and Technology (ICICDT), Austin TX, Extending Energy-Saving Voltage Scaling in Ultra Low Voltage Integrated Circuit Designs, May 2012
- (3) Polytechnic Institute of New York University, Brooklyn NY, The Next Class of Computing: Millimeter-Scale," Nanoelectronic Devices for Defense and Security Conference, Aug. 2011
- (2) Faculty Candidate Talks, University of Southern California, Columbia University, University of Washington at Seattle, Extremely Energy Efficient Circuit and System Design for Millimeter-Scale Medical Devices, Mar. 2011
- (1) Job Talks, IBM TJ Watson Research Center, Intel Advanced Technology Development, AMD Research and Advanced Development Labs, Oracle Sun Lab, Texas Instruments Systems and Applications R&D Center, Extreme-Power Constrained Integrated Circuit Design, Jul.-Nov., 2010

## Service

<u>Activity</u>	<u>Beginning</u>	<u>Ending</u>
Computer Engineering Program Committee, Member	2012	present
EE Computing Labs Committee, Chair	2018	present
EE Distinguished Lecture Committee, Member	2018	present
EE Newsletter & Website, Member	2018	present
EE Computing Committee, Chair	2013	2017



## Professional Services

### Editorial work

- (5) Associate Editor - IEEE Solid-State Circuits Letters (SSCL), 2017-present
- (4) Associate Editor - IEEE Transactions on Very Large Scale Integration (VLSI) Systems, 2015-present
- (3) Guest Editor - IEEE Journal of Solid-State Circuits (JSSC), the special issue of 2019 IEEE International Solid-State Circuits Conference (ISSCC), 2019
- (2) Associate Editor - IEEE Transactions on Circuits and Systems I: Regular Papers, 2014-2016
- (1) Reviewer - IEEE Journal of Solid-State Circuits, IEEE Transactions on Very Large Scale Integration Systems, IEEE Transactions on Circuits and System I and II, IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, IEEE Journal on Emerging and Selected Topics in Circuits and Systems (JETCAS)

### Conference Organization and Technical Program Committee

- (12) Technical program committee member, Digital Circuits (DCT), IEEE International Solid-State Circuits Conference (ISSCC), 2019-present
- (11) Technical program committee member, Student Research Preview (SRP), IEEE International Solid-State Circuits Conference (ISSCC), 2018-present
- (10) Technical program committee member, Power Management, IEEE Custom Integrated Circuits Conference (CICC), 2017-2019
- (9) Special Session Co-Organizer, Panels, IEEE Custom Integrated Circuits Conference (CICC), 2018-2019
- (8) Technical program committee member, Digital Circuits and Technology, ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED), 2013-2018
- (7) Student Design Contest Co-Chair, ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED), 2013-2014
- (6) Technical program committee member, Reliability Circuits, IEEE International Reliability Physics Symposium (IRPS), 2018-present
- (5) Technical program committee member, Subthreshold Circuits - IEEE SOI-3D-Subthreshold Microelectronics Technology Unified Conference (S3S), 2014-present
- (4) Technical program committee member, Digital Design, IEEE International Conference on Computer Design (ICCD), 2013 and 2015-2018
- (3) Technical program committee member, Computing Systems, IEEE International Conference on Computer Design (ICCD), 2017
- (2) Registration Co-Chair, IEEE International Conference on Computer Design (ICCD), 2015-2017
- (1) Technical program committee member, Digital Design, IEEE/ACM International Conference on VLSI Design (VLSID), 2013, 2016, 2017

### Workshop, Forum, Panel Organizations

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- (8) A special session in 2019 Great Lakes Symposium on VLSI (GLSVLSI), Recent Advances in Near and In-Memory Computing Circuit and Architecture for Artificial Intelligence and Machine Learning, Introduction of the recent advances in near and in-memory computing circuits and architectures for artificial intelligence and machine learning, Co-organize with Prof. Tinoosh Mohasen, Washington, D.C., USA, May, 2019
- (7) A special session in 2018 IEEE Biomedical Circuits and Systems Conference (BioCAS), Low-Power On-Chip Machine Learning, Discuss the recent advances in low-power on-chip machine learning, Co-organize with Profs. Zhengya Zhang and Naresh Shanbhag, Cincinnati OH, USA, Aug., 2018
- (6) A forum in 2018 IEEE Custom Integrated Circuits Conference (CICC), The Next Waves of Machine/Deep Learning Hardware, Discuss the emerging trends and directions on deep learning hardware design, co-organize with the chair (Jae-Sun Seo at ASU). The forum participants are: Leland Chang (IBM), Chris Nicol (Wave Computing), Vivienne Sze (MIT), Anand Raghunathan (Purdue), Dmitri Strukov (UCSB)
- (5) panel discussion in 2017 Custom Integrated Circuits Conference (CICC), Bio-Inspired Learning and Inference Systems: What Works Well and What didn't. Discuss the successes and challenges in bio-inspired learning and inference systems design, Organize together with Prof. Jae-Sun Seo (ASU, co-chair); Panelists: Rajit Manohar (Yale), Vijaykrishnan Narayanan (PSU), Gert Cauwenberghs (UCSD), Ram Krishnamurthy (Intel), Andrew Cassidy (IBM), Austin TX, USA, Apr., 2017
- (4) Columbia Integrated System Laboratory (CISL) Seminar Series, organizing more than 30 seminars, 2013-2017
- (3) IEEE SSCS Distinguished Lecture Tour: Half-Day Colloquium on the Recent Advances in RF, Mixed-Signal, and Digital IC designs; Organize; sponsored by IEEE EDS/SSCS and Columbia University; Dec. 4, 2015
- (2) IEEE SSCS Distinguished Lecture Tour: Half-Day Colloquium on the Recent Advances in RF, Mixed-Signal, and Digital IC designs; Organize; sponsored by IEEE EDS/SSCS and Columbia University; Oct. 17, 2014
- (1) Workshop on Connected, Autonomously Powered Systems; A one-day in-depth discussion of the issues required to address the challenge of bringing energy harvesting, wireless communication, and self-powered systems to market; Co-Organize with Prof. John Kymissis and Prof. Harish Krishinawamy; sponsored by IEEE EDS/SSCS and Columbia University; Apr. 11 2014

#### Proposal Reviewing

- (4) National Science Foundation
- (3) National Science Foundation Small Business Innovation Research (SBIR)
- (2) Israeli Ministry of Science, Technology and Space
- (1) Columbia University Office of the Executive Vice President for Research

#### Service to Professional Societies

- (3) Treasurer, IEEE New York Section EDS/SSCS Chapter, 2016-present
- (2) Chair, IEEE New York Section EDS/SSCS Chapter, 2014-2015
- (1) Vice Chair, IEEE New York Section EDS/SSCS Chapter, 2012-2013

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## Current Professional Organization Membership

- (2) IEEE Senior Member (2018); Member (2012); Student Member (2006)
- (1) ACM Member (2019)

## Consulting Record

<u>Firm</u>	<u>Beginning</u>	<u>Ending</u>
<a href="#">Korea Advanced Institute of Science and Technology</a>	2019	Present
<a href="#">Vitcon</a>	2017	Present
<a href="#">TexasLDPC</a>	Jul. 2015	Dec. 2015

## Thesis Supervised

### Summary

	<u>Total</u>	<u>Completed</u>	<u>In Progress</u>
B.S.	6	5	1
M.S.	33	32	1

  

<u>Doctoral</u>			
As Supervisor:	14	3	11
As Reader:	18	16	2

### B.S. Thesis and Research Supervising

- (6) Jay Mok, In-DRAM computing, 2019 (expected)
- (5) Saarthak Sarup, Neural network memory capacity, 2018, Ph.D. in Stanford Univ.
- (4) Harrison Liew, FPGA chip architecture, 2017, Ph.D. in UC-Berkeley
- (3) Andreas Hoffman, Energy-efficient motor control, 2014, Innsbruck
- (2) Christopher Hong, Ultra-low-power processor, 2013, Bloomberg
- (1) Kyung Min Lee, Ultra-low-power processor, 2013, Cornell

### M.S. Thesis and Research Supervising

- (33) Yuchan Hsueh, MS, TBD, 2019 (expected)
- (32) Dewei Wang, Event-driven neural networks, 2018, Columbia Univ.
- (31) David Zuo, Event-driven neural networks, 2018, Qualcomm
- (30) Ajay Kumar Sidhar, Memory capacity monitoring, 2018, Apple
- (29) Yucan Liu, Event-driven neural networks, 2018, Snowflake
- (28) Gautham Harinarayan, In-RRAM computing, 2018
- (27) Varun Ahalawat, In-DRAM computing, 2018
- (26) Blayne Kettlewell, Custom FPGA design and implementation, 2017, Magnetic Ins.

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- (25) David Yu, Custom FPGA design and implementation, 2017, Startup
- (24) Tom Cheng, Custom FPGA design and implementation, 2017
- (23) Sung Justin Kim, Hybrid comparator circuits, 2017, Columbia Univ.
- (22) Yuxiang Chen, Clock domain crossing, 2017, Micron
- (21) Song Wang, Neural signal compression systems, 2017, Intel
- (20) Simarpreet Chawla, Neural signal compression systems, 2017, Qualcomm
- (19) Sheng Zhang, Embedded AI for chip security, 2017, TSMC
- (18) Shijian Chi, Occupancy sensing systems, 2017
- (17) Chuanjun Shan, Occupancy sensing systems, 2017
- (16) Yini Zhou, Fine-grained thermal monitoring, 2016, Broadcom
- (15) Zhewei Jiang, Low-power cognitive computing, 2015, Columbia Univ.
- (14) Zhenyu Zhu, Ultra-low-power processor, 2014, Cavium
- (13) Beinuo Zhang, Low-power cognitive computing, 2014, Oracle
- (12) Cong Zhu, Low-power floating point unit design, 2014, Oracle
- (11) Jiachen Li, Crosstalk noise analysis, 2014, Oracle
- (10) Hongsen Yu, On-chip SRAM design, 2013, Marvell
- (9) Zhe Cao, Pipeline and parallel architecture, 2013, Marvell
- (8) Jiangyi Li, Aging monitoring technique, 2013, Columbia Univ.
- (7) Artem Lakoviev, OFET design flow, 2013, Argo-Logic
- (6) Jian Liu, Asynchronous pipeline design, 2012, Qualcomm
- (5) Hongtao Li, Active decoupling capacitor design, 2012, LSI
- (4) Junyan Gao, Digital differential analyzer, 2012, SanDisk
- (3) Kevin Kuo, Design flow exploration, 2012, Qualcomm
- (2) Changzhuo Chen, Temperature sensor design, 2012, CAS
- (1) Masayuki Pak, Power grid integrity analysis, 2012, Sony

Doctoral Thesis, Supervisor

- (14) Daniel Jang, Analog/digital acoustic processing hardware; advising, 2019-2023 (estimated)
- (13) Ayushparth Sharma, Ultra-low-power coarse grained array accelerator; advising, 2019-2023 (estimated)
- (12) Mohammed Javad Karimi, Analog/digital acoustic processing hardware; co-advising with Prof. Yannis Tsividis, 2019-2023 (estimated)
- (11) Bo Zhang, Mixed-signal AI hardware; advising, 2018-2023 (estimated)
- (10) Ashish Shukla, Super-conducting digital mixed-signal circuits; advising, 2019-2023 (estimated)
- (9) Dongkwon Kim, Integrated power converter and load codesign; advising, 2017-2022 (estimated)
- (8) Sung Kim, Integrated and distributed regulators; advising, 2017-2022 (estimated)

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- (7) Pavan Kumar Chundi, On-chip machine learning; advising, 2016-2021 (estimated)
- (6) Zhewei Jiang, Low-power machine learning and AI hardware; advising, 2015-2020 (estimated)
- (5) Joao Pedro Cerqueira, Active leakage suppression techniques; advising, 2014-2019 (estimated)
- (4) Doyun Kim, Event-driven control circuits and systems; advising, 2013-2019; Facebook
- (3) Jiangyi Li, [Scalable power and security circuits](#); advising, 2013-2018; Apple
- (2) Teng Yang, Area-efficient on-chip thermal and aging monitoring; co-advising with Prof. Peter R. Kinget, 2012-2019, Intel AD
- (1) Seongjong Kim, [Near/sub- \$V\_T\$  variation-adaptive processors](#); advising, 2012-2016, Intel CRL

Doctoral Thesis, As Reader (On Thesis Committee)

#### **Ph.D. Thesis Committee**

- (15) Zheng Shou, Committee, Deep Learning for Action Understanding in Video, 2019, TBD
- (14) Andrea Lottarini, Committee, Design Space Exploration of Accelerators for Warehouse Scale Computing, 2019, Google
- (13) Kevin Tien, Committee, Integrated Inductor based DCDC Converter, 2018, IBM
- (12) Linxiao Zhang, RF/Analog Spatial Equalization for Integrated Digital MIMO Receivers, 2017
- (11) Jeffrey Chuang, RF Mixed-signal Phase-Locked Loop (PLL) for Broadband radio, 2017
- (10) Jahnavi Sharma, CMOS Synthesizers for Emerging RF-to-Optical Applications, 2017
- (9) Ning Guo, Investigation of Energy-Efficient Hybrid Analog Digital Approximate Computation in Continuous Time, 2016, Startup
- (8) Yu Chen, Digital Signal Processing with Signal-Derived Timing: Analysis and Implementation, 2016, Apple
- (7) Sharvil Patil, Energy-Efficient Time-based Encoders and Digital Signal Processors in Continuous Time, 2016, Analog Devices
- (6) Fabio Carte, Low Temperature Monolithic Integration for Silicon and Organic Electronics, 2015, IBM TJ Watson
- (5) Chun-Wei Hsu, Challenges and Solutions for High Performance Analog Circuits with Robust Operation in Low Power Digital CMOS, 2015, Analog Dev.
- (4) Jayanth Kuppambatti, Mixed-Signal Design Techniques in Scaled CMOS, 2014, Startup
- (3) Chengrui Le, Efficient and Integrated Switched-Capacitor Converter, 2014, Apple
- (2) Christos Vezyrtzis, Continuous Time DSP, 2013, IBM TJ Watson
- (1) John Sarik, Systems for Pervasive Electronics and Interfaces, 2013

#### **Visiting Ph.D. Advisor**

- (3) Peiye Liu, visiting PhD, Memory-efficient neural architecture search, 2017-2019 (estimated)
- (2) Tianchan Guan, visiting PhD advisor, Scalable synaptic memory model, 2015-2018
- (1) Wei Jin, visiting PhD advisor, Ultra-low voltage sequencing circuits, 2014-2016

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### Current Research Group

- (11) Bo Zhang, MS/PhD, Mixed-signal AI hardware; advising, 2018-2023 (estimated)
- (10) Ashish Shukla, PhD, Super-conducting digital mixed-signal circuits; advising, 2019-2023 (estimated)
- (9) Dongkwon Kim, PhD, Integrated power converter and load codesign; advising, 2017-2022 (estimated)
- (8) Sung Kim, PhD, Integrated and distributed regulators; advising, 2017-2022 (estimated)
- (7) Pavan Kumar Chundi, MS/PhD, On-chip machine learning; advising, 2016-2021 (estimated)
- (6) Zhewei Jiang, PhD, Low-power machine learning and AI hardware; advising, 2015-2020 (estimated)
- (5) Joao Pedro Cerqueira, MS/PhD, Active leakage suppression techniques; advising, 2014-2019 (estimated)
- (4) Teng Yang, PhD, Area-efficient on-chip thermal and aging monitoring; co-advising with Prof. Peter R. Kinget, 2012-2019, Intel AD
- (3) Peiye Liu, visiting PhD, Memory-efficient neural architecture search, 2017-2019 (estimated)
- (2) Yuchan Hsueh, MS, TBD, 2019 (expected)
- (1) Jay Mok, BS, In-DRAM computing, 2019 (expected)

### Postdoctoral Associates

- (3) Hyuk-jae Lee, Sep. 2018 - Dec. 2018, Professor, Seoul National University, Seoul, Republic of Korea
- (2) Weiwei Shan, 2017-2019, Associate Professor, Southeast University, Nanjing, China
- (1) Minhao Yang, 2016-2018, EPFL, Lausanne, Switzerland, Scientist

## Teaching Experience

### At Columbia University

Term	Subject Number	Title	Role
2019 Spring	EECSE6321	Advanced Digital Electronic Circuits	Lecturer
2018 Fall	CSEEW4823	Advanced Logic Design	Lecturer
2018 Spring	CSEEW4823	Advanced Logic Design	Lecturer
2017 Fall	EECSE6322	VLSI Arch. for DSP and ML	Lecturer
2017 Spring	EECSE6321	Advanced Digital Electronic Circuits	Lecturer
2016 Fall	EECSE6322	VLSI Arch. for DSP and ML	Lecturer
2016 Spring	EECSE6321	Advanced Digital Electronic Circuits	Lecturer
2015 Fall	ELENE6920	VLSI Arch. for DSP and ML	Lecturer
2015 Spring	EECSE6321	Advanced Digital Electronic Circuits	Lecturer
2014 Fall	ELENE6920	VLSI Arch. for DSP and ML	Lecturer
2014 Spring	EECSE6321	Advanced Digital Electronic Circuits	Lecturer
2013 Spring	EECSE6321	Advanced Digital Electronic Circuits	Lecturer
2012 Spring	EECSE6321	Advanced Digital Electronic Circuits	Lecturer

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Outside Columbia University

### Short courses

- (3) Near/Sub-Threshold Voltage Circuits and Architectures for Digital Processors, Introductory course focusing on state of the art circuit and architecture techniques for ultra-low-power ( $\mu\text{W}$  and sub- $\mu\text{W}$ ) digital VLSI design, Seven lectures, three hours per lecture. Host: Prof. Weifeng He, Shanghai Jiao Tong University, Shanghai, China, July., 2018
- (2) Near/Sub-Threshold Circuits and Architectures for Microprocessors, Introduce key circuit and architecture techniques for designing ultra-low-power computing hardware (e.g., microprocessors) in near/sub-threshold digital circuits for creating ultra-low-power Internet of the Things (IoT) devices. A part of Global Initiative of Academic Network (GIAN) programme, Five lectures, three hours per lecture, assignments, and an exam, Indian Institute of Technology, Madras, India, Jan., 9-13, 2017
- (1) Enabling Technologies for Data Science and Analytics: the Internet of Things, Contributing segments: (1) ultra-low-power computing hardware and (2) machine-learning hardware, Offered via the edX ([link](#)) from 7/Mar/2016

### Conference tutorials

- (3) Emerging Topics in Analog-Hybrid All-Programmable Embedded Computing, Introduction of the recent advances on analog, mixed-signal, hybrid analog-digital, and RF computing technologies, 2 hour session in 2018 Embedded Systems Conference (ESC) Minneapolis, Co-organize with Profs. Arjuna Madanayake (The University of Akron) and Soumyajit Mandel (Case Western Reserve University), Minneapolis MN, USA, Nov., 2018
- (2) Towards Energy-Efficient Intelligence in Power/Area-Constrained Hardware, Introduce recent algorithm, architecture, circuit, device co-design techniques to implement intelligence in compact, low-power devices, A 40-min lecture (out of three 40-min lectures) in 2017 Asian and South Pacific Design Automation Conference (ASP-DAC), Together with Prof. Jae-Sun Seo (ASU) and Prof. Zhengya Zhang (UMichigan), Chiba/Tokyo, Japan, Jan. 16, 2017
- (1) Variation-Adaptive Design in Near/Sub-Threshold Voltage Digital Computing Hardware, Introduce recent and important techniques to design computing hardware in near/sub-threshold digital circuits for creating the ultra-low-power IoT devices. One hour tutorial (out of three 1-hr tutorials) during 2016 IEEE SOI-3D-Subthreshold Microelectronics Technology Unified Conference (S3S), Together with Prof. Massimo Alioto (NUS) and Prof. Hanh-Phuc Le (Colorado), San Jose, CA, USA, Oct. 10, 2016

## Teaching Innovation

- (3) CSEEW4823: Significantly updated it with a new set of lecture slides, lab sessions, and a final project
- (2) EECSE6322: Newly created
- (1) EECSE6321: Newly created after more than 10 years of the absence in the department curricula

## **Outreach Efforts**

- (11) Seoul Science High School, "The Future of AI is Small," Oct., 2018
- (10) KSEA Youth Science and Technology Leadership Camp "Internet-of-Things X Machine-Learning," Aug., 2018
- (9) Seoul Science High School, "Internet-of-Things X Machine-Learning," Oct., 2017
- (8) Seoul Science High School, "Internet-of-Things X Machine-Learning," Oct., 2016
- (7) Math Minds, "Introduction to Circuits", Jun., 2016
- (6) Booker T Washington Middle School 54, "Introduction to Circuits", May, 2016
- (5) Seoul Science High School, "Introduction to Modern Integrated Circuit Design", Oct., 2015
- (4) Society of Women Engineers (SWE), "Engineering Exploration Experience (EEE)", Mar. 2015
- (3) Columbia University Outreach Office and Seoul Science High School, "Introduction to Modern Integrated Circuit Design," Oct., 2014
- (2) Johns Hopkins Center for Talented Youth and Columbia SEAS Outreach Office, "Full-day Workshop on Engineering and Applied Science", Co-organize with Prof. Javad Lavaei, Prof. Christine P. Fleming, and Prof. Shiho Kawashima, Sep. 20, 2014
- (1) Columbia University Outreach Office and Seoul Science High School, "Introduction to Engineering", Oct. 2013