

Mingoo Seok

Mingoo Seok
Associate professor
Electrical Engineering (also with Computer Engineering)
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Principal Field of Interest

Very large scale integration (VLSI) hardware design

Seok's field of research is to design general-purpose and specialized computing systems in the form of integrated circuits. The foci are given to: i) ultra-low power architecture for artificial intelligence and machine learning, ii) variation-tolerent hardware architecture, iii) integrated power management circuits, and iv) hybrid analog digital computing hardware.

Education

| <u>School</u> | <u>Degree</u> | <u>Date</u> |
|---|--|-------------|
| University of Michigan, Ann Arbor, MI, USA | Ph.D. in EE Advisor: Dennis Sylvester | 2007-2010 |
| University of Michigan, Ann Arbor, MI, USA | M.S in EE | 2005-2007 |
| Seoul National University, Seoul, South Korea | B.S. in EE, <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](#)

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. 2012 | 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

- (10) AMiner AI2000 Chip Technology Most Influential Scholars, Honorable Mention (Top 11-100 Scholars), 2020
- (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 = 47 (peer-reviewed journal), 96 (peer-reviewed conference); h-index = 29; i10-index = 63; total citation count = 3761 (4/2021); based on the Google Scholar
- Authorship convention: the first author who performs the bulk of the experimental work; the last author who directs research and the preparation of the manuscript; other authors listed in between in the order of the magnitude of their contributions.
- The underlined persons are/were directly advised by Seok in Columbia University.

Papers in Referred Journals

2021

- (47) Minhao Yang, Hongjie Liu, Weiwei Shan, Jun Zhang, Ilya Kiselev, Sang Joon Kim, Christian Enz, Mingoo Seok, "Nanowatt Acoustic Inference Sensing Exploiting Nonlinear Analog Feature Extraction," *IEEE Journal of Solid-State Circuits (JSSC)*, 2021
- (46) Fred Douglass, Seth Robertson, Eric van den Berg, Josephine Micallef, Marc Pucci, Alex Aiken, Keren Bergman, Maarten Hattink, Mingoo Seok, "FLEET– Fast Lanes for Expedited Execution at 10 Terabits: Program Overview," *IEEE Internet Computing*, 2021
- (45) Eren Kurshan, Hai Li, Mingoo Seok, Yuan Xie, "A Case for 3D Integrated System Design for Neuromorphic Computing and AI Applications," *International Journal of Semantic Computing*, 2021

- (44) Sung Justin Kim, Soo Bong Chang, Mingoo Seok, "A High PSRR, Low Ripple, Temperature-compensated, 10- μ A-Class Digital LDO based on Current-Source Power-FETs for a Sub-mW SoC," *IEEE Solid-State Circuits Letter (SSCL)*, 2021
- (43) Sung Justin Kim, Dongkwun Kim, Yu Pu, Chunlei Shi, Soo Bong Chang, Mingoo Seok, "0.5-1V, 90-400mA, Modular, Distributed, 3X3 Digital LDOs based on Event-Driven Control and Domino Sampling and Regulation," *IEEE Journal of Solid-State Circuits (JSSC)*, 2021
- (42) Dongkwun Kim, Sung Justin Kim, Zhewei Jiang, Suhwan Kim, Andres Blanco, Ram Krishnamurthy, Mingoo Seok, "A 10-Output, Integrated-Output-Capacitor Single-Inductor-Multiple-Output DC-DC Buck Converter with Integrated Output Capacitors for a Sub-mW System-on-Chip," *IEEE Solid-State Circuits Letter (SSCL)*, 2021

2020

- (41) Chuxiong Lin, Weifeng He, Yanan Sun, Bingxi Pei, Pavan Kumar Chundi, Zhigang Mao, Mingoo Seok, "MEDAC: A Metastability Condition Detection and Correction Technique for a Near-Threshold-Voltage Multi-Voltage/Frequency-Domain Network-on-Chip," *IEEE Journal of Solid-State Circuits (JSSC)*, 2020,
- (40) Zhewei Jiang, Shihui Yin, Jae-sun Seo, Mingoo Seok, "C3SRAM: An In-Memory-Computing SRAM Macro Based on Robust Capacitive Coupling Computing Mechanism," *IEEE Journal of Solid-State Circuits (JSSC)*, 2020, *invited*
- (39) Joao Pedro Cerqueira, Tomas J. Repetti, Yu Pu, Shivam Priyadarshi, Martha A. Kim, Mingoo Seok, "Catena: A Near-Threshold Sub-0.4-mW 16-Core Programmable Spatial Array Accelerator for the Ultra-Low-Power Mobile and Embedded Internet of Things," *IEEE Journal of Solid-State Circuits (JSSC)*, 2020
- (38) Shihui Yin, Zhewei Jiang, Jae-sun Seo, Mingoo Seok, "XNOR-SRAM: In-Memory Computing SRAM Macro for Binary and Ternary Deep Neural Networks," *IEEE Journal of Solid-State Circuits (JSSC)*, 2020, [link](#)
- (37) Weiwei Shan, Wentao Dai, Liang Wan, Longxing Shi, Mingoo Seok, Jun Yang, "A Bi-directional, Zero-latency Adaptive Clocking Circuit in a 28nm Wide AVFS System," *IEEE Journal of Solid-State Circuits (JSSC)*, 2020, [link](#)

2019

- (36) Doyun Kim, Peter R. Kinget, Mingoo Seok, "SRAM-ADC: SRAM Circuits Transformable to a Stochastic ADC at Ultra-Low Area Overhead," *IEEE Solid State Circuits Letter (SSCL)*, 2019, [link](#)
- (35) Zhewei Jiang, Shihui Yin, Jae-sun Seo, Mingoo Seok, "C3SRAM: In-Memory Computing SRAM Macro Based on Capacitive-Coupling Computing," *IEEE European Solid-State Circuits Conference (ESSCIRC)*, 2019, *cross-published in IEEE Solid State Circuits Letter (SSCL)* [link](#)
- (34) Shihui Yin, Zhewei Jiang, Minkyu Kim, Tushar Gupta, Mingoo Seok, Jae-sun Seo, "Vesti: Ultra-Energy-Efficient In-Memory Computing Accelerator for Deep Neural Networks," *IEEE Transactions on VLSI Systems (TVLSI)*, 2019, [link](#)
- (33) 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)*, 2019, [link](#)

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- (32) 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)*, 2019 , [link](#)
- (31) 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 , [link](#)
2018
- (30) Joao Pedro Cerqueira, Jiangyi 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 , [link](#)
- (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, [link](#)
- (28) Sung Justin Kim, Doyun Kim, Jonghwan Kim, Hyunju Ham, Mingoo Seok, "A 67.1-ps FOM, 0.5-V-Hybrid Digital LDO With Asynchronous Feedforward Control Via Slope Detection and Synchronous PI With State-Based Hysteresis Clock Switching," *IEEE Solid State Circuits Letter (SSCL)*, 2018 , [link](#)
- (27) Teng Yang, Doyun Kim, Jiangyi 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, [link](#)
- (26) Seongjong Kim, Mingoo Seok, "A Sub- $50 \mu m^2$, 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 , [link](#)
- (25) Jiangyi Li, Teng Yang, Minhao Yang, Peter R. Kinget, Mingoo Seok, "An Area-Efficient Microprocessor-Based SoC With an Instruction-Cache Transformable to an Ambient Temperature Sensor and a Physically Unclonable Function," *IEEE Journal of Solid-State Circuits (JSSC)*, 2018, *invited for the special issue* , [link](#)
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 , [link](#)
- (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 , [link](#)
- (22) Jiangyi 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* , [link](#)
- (21) Yipeng Huang, Ning Guo, Mingoo Seok, Yannis Tsvividis, 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* , [link](#)
2016

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- (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 , [link](#)
 - (19) Jiangyi 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 , [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 Passing: Cross-Layer Design," *IEEE Transactions on Circuits and Systems I (TCAS-I)*, 2016 , [link](#)
 - (17) Daniel Marti, Mattia Rigotti, Mingoo Seok, Stefano Fusi, "Energy-Efficient Neuromorphic Classifier," *Neural Computation (NECO)*, 2016 , [link](#), preprint is uploaded at [ArXiv](#)
 - (16) Ning Guo, Yipeng Huang, Tao Mai, Shavil Patil, Chi Cao, Mingoo Seok, Simha Sethumadhavan, Yannis Tsvividis, "Low-Energy Hybrid Analog/Digital Approximate Computation in Continuous Time," *IEEE Journal of Solid-State Circuits (JSSC)*, 2016, invited for the special issue , [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 , [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 , [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 , [link](#)
- 2013: Pre-Columbia**
- (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 , [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 , [link](#)
 - (10) Matthew Fojtik, Daeyeon Kim, Gregory K. Chen, Yu-Shiang Lin, David Fick, Junsun Park, Mingoo Seok, Mao-Ter Chen, Zhiyong 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 , [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 , [link](#)

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- (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 , [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 , [link](#)

2011

- (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 , [link](#)
- (5) Mingoo Seok, Gregory Chen, Scott Hanson, Michael Wiecekowsk, 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 , [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 , [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 , [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 , [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 , [link](#)

Proceedings of Referred Conferences

2021

- (96) Sung Justin Kim, Dongkwun Kim, Ayushparth Sharma, Mingoo Seok, "EQZ-LDO: A Near-Zero EDP Overhead, >10M-Attack-Resilient, Secure Digital LDO featuring Attack-Detection and Detection-Driven Protection for a Correlation-Power-Analysis-Resilient IoT Device," *IEEE Symposium on VLSI Circuits (VLSI)*, 2021
- (95) Shihui Yin, Bo Zhang, Minkyu Kim, Jyotishman Saikia, Soon-Wan Kwon, Sungmeen Myung, Hyunsoo Kim, Sang Joon Kim, Mingoo Seok, Jae-sun Seo, "PIMCA: A 3.4-Mb Programmable In-Memory Computing Accelerator in 28nm CMOS for On-Device Deep Neural Networks," *IEEE Symposium on VLSI Circuits (VLSI)*, 2021

- (94) Hao Zhang, Weifeng He, Yanan Sun, Mingoo Seok, "An Energy-Efficient Logic Cell Library Design Methodology with Fine Granularity of Driving Strength for Near- and Sub-Threshold Digital Circuits", *IEEE International Symposium on Circuits and Systems (ISCAS)*, 2021
 - (93) Hao Zhang, Jieyu Li, Weifeng He, Yanan Sun, Mingoo Seok, "An Ultra-Low Leakage Bitcell Structure with the Feedforward Self-Suppression Scheme for Near-Threshold SRAM", *IEEE International Symposium on Circuits and Systems (ISCAS)*, 2021
 - (92) Jieyu Li, Zihan Lian, Hao Zhang, Weifeng He, Yanan Sun, Mingoo Seok, "Investigation of Dynamic Leakage-Suppression Logic Techniques Crossing Different Technology Nodes from 180 nm Bulk CMOS to 7 nm FinFET Plus Process", *IEEE International Symposium on Circuits and Systems (ISCAS)*, 2021
 - (91) Sai Kiran Cherupally, Adnan Rakin, Shihui Yin, Mingoo Seok, Deliang Fan, Jae-sun Seo, "Leveraging Variability and Aggressive Quantization of In-Memory Computing for Robustness Improvement of Deep Neural Network Hardware Against Adversarial Input and Weight Attacks," *ACM/EDAC/IEEE Design Automation Conference (DAC)*, 2021
 - (90) Chuxiong Lin, Weifeng He, Yanan Sun, Zhigang Mao, Mingoo Seok, "CDAR-DRAM: An In-situ Charge Detection and Adaptive Data Restoration DRAM Architecture for Performance and Energy Efficiency Improvement," *ACM/EDAC/IEEE Design Automation Conference (DAC)*, 2021
 - (89) Jyotishman Saikkia, Shihui Yin, Bo Zhang, Mingoo Seok, Jae-sun Seo, "Modeling and Optimization of SRAM-based In-Memory Computing Hardware Design," *Design, Automation, and Test in Europe (DATE)*, 2021
 - (88) Dewei Wang, Sung Justin Kim, Minhao Yang, Aurel A. Lazar, Mingoo Seok, "A Background-Noise- and Process-Variation-Tolerant 109-nW Acoustic Feature Extractor based on Spike-Domain Divisive Energy Normalization for an Always-on Keyword Spotting Device", *IEEE International Solid-State Circuits Conference (ISSCC)*, 2021
- 2020**
- (87) Dewei Wang, Pavan Kumar Chundi, Sung Justin Kim, Minhao Yang, Joonsung Kang, Seungchul Jung, Sangjoon Kim, Mingoo Seok, "Always-On, Sub-300nW, Event-Driven Spiking Neural Network based on Spike-Driven Clock-Generation and Clock- and Power-Gating for an Ultra-Low-Power Intelligent Device," *IEEE Asian Solid-State Circuits Conference (ASSCC)*, 2020
 - (86) Dongkwun Kim, Yoshitaka Yamauchi, Xiaodong Meng, Tianyu Jia, Liam McAuliffe, Todd Takken, Shurong Tian, Andrew Ferencz, Mingoo Seok, and Xin Zhang, "A 48V-to-0.75V Active-Clamp Forward Converter Power Block with Integrated Programmable Gate Timing Control and Gate Drivers," *IEEE Energy Conversion Congress and Exposition (ECCE)*, 2020
 - (85) Peiye Liu, Wu Liu, Huadong Ma, Zhewei Jiang, Mingoo Seok, "KTAN: Knowledge Transfer Adversarial Network," *IEEE International Joint Conference on Neural Networks (IJCNN)*, 2020
 - (84) Peiye Liu, Bo Wu, Huadong Ma, Mingoo Seok, "MemNAS: Memory-Efficient Neural Architecture Search with Grow-Trim Learning," *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2020
 - (83) Chuxiong Lin, Weifeng He, Yanan Sun, Zhigang Mao, Bingxi Pei, Mingoo Seok, "A Near-Threshold-Voltage Network-on-Chip with a Metastability Error Detection and Correction Tech-

- nique for Supporting a Quad-Voltage/Frequency-Domain Ultra-Low-Power System-on-a-Chip," *IEEE International Solid-State Circuits Conference (ISSCC)*, 2020
- (82) Weiwei Shan, Minhao Yang, Jiaming Xu, Shuai Zhang, Chengjun Wu, Longxing Shi, Jun Yang and Mingoo Seok, "A 510nW, 0.41V low-memory, low-computation keyword spotting chip using serial FFT based MFCC and binarized depthwise separable convolutional neural network in 28nm CMOS," *IEEE International Solid-State Circuits Conference (ISSCC)*, 2020
2019
- (81) Zhewei Jiang, Shihui Yin, Minkyu Kim, Tushar Gupta, Mingoo Seok, Jae-sun Seo, "Vesti: An In-Memory Computing Processor for Deep Neural Networks Acceleration," *IEEE Asilomar Conference on Signals, Systems, and Computers*, 2019, *invited*
- (80) Minhao Yang, Shih-Chii Liu, Mingoo Seok, Christian Enz, "Ultra-Low-Power Intelligent Acoustic Sensing using Cochlea-Inspired Feature Extraction and DNN Classification," *IEEE International Conference on ASIC (ASICON)*, 2019, *invited*, [link](#)
- (79) Joao Pedro Cerqueira, Jieyu Li, Hao Zhang, Jiangyi Li, Weifeng He, Mingoo Seok, "A Femto/Pico-Watt Feedforward Leakage Self-Suppression Logic Family in 180 nm to 28 nm Technologies," *IEEE International Midwest Symposium on Circuits and Systems (MWSCAS)*, 2019, *invited*, [link](#)
- (78) Pavan Kumar Chundi, Peiye Liu, Sangsu Park, Seho Lee, Mingoo Seok, "FPGA-based Acceleration of Binary Neural Network Training with Minimized Off-Chip Memory Access," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, 2019, [link](#)
- (77) Jyotishman Saikia, Shihui Yin, Zhewei Jiang, Mingoo Seok, Jae-sun Seo, "K-Nearest Neighbor Hardware Accelerator Using In-Memory Computing SRAM," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, 2019, [link](#)
- (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, [link](#)
- (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, [link](#)
- (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, [link](#)
- (73) Andrea Lottarini, Joao Pedro Cerqueira, Tom Repetti, Stephan A. Edwards, Kenneth A. Ross, Mingoo Seok, Martha Kim, "Master of None Acceleration: A Comparison of Accelerator Architectures for Analytical Query Processing," *ACM/IEEE International Conference on Computer Architecture (ISCA)*, 2019, [link](#)
- (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*, [link](#)
- (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*, [link](#)
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, [link](#)
 - (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, [link](#) , 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- μ 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 , [link](#)
 - (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 , [link](#)
 - (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 , [link](#)
 - (65) Zhewei Jiang, Shihui Yin, Mingoo Seok, Jae-Sun Seo, "XNOR-SRAM: In-Memory Computing SRAM Macro for Binary/Ternary Deep Neural Networks," *IEEE Symposium on VLSI Technology (VLSIT)*, 2018 , [link](#)
 - (64) Doyun Kim, Sung Justin Kim, Jonghwan Kim, Hyunju Ham, Mingoo Seok, "0.5V- V_{IN} , 165- mA/mm^2 Fully-Integrated Digital LDO based on Event-Driven Self-Triggering Control," *IEEE Symposium on VLSI Circuits (VLSIC)*, 2018 , [link](#)
 - (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 , [link](#)
 - (62) Minhao Yang, Chung-Heng Yeh, Yiyin Zhou, Joao Pedro Cerqueira, Aurel Lazar, Mingoo Seok, "1- μ W Voice Activity Detector using Analog Feature Extraction and Digital Deep Neural Network," *IEEE International Solid-State Circuits Conference (ISSCC)*, 2018 , [link](#)
- 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
 - (60) Tom Repetti, Joao Pedro Cerqueira, Martha Kim, Mingoo Seok, "Pipelining a Triggered Processing Element," *IEEE/ACM Symposium on Microarchitecture (Micro)*, 2017, , [link](#)
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Other Non-Referred Publications

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- (26) Ashish Shukla, Timur V. Filippov, Dmitri E. Kirichenko, Anubhav Sahu, Mingoo Seok, and Deepnarayan Gupta "Current Management Techniques for Serially Biased RSFQ Circuits," poster presentation, *IEEE Applied Superconductivity Conference (ASC)*, 2020
- (25) Zhewei Jiang, Jiangyi Li, Pavan Kumar Chundi, Sung Justin Kim, Minhao Yang, Joonseong Kang, Seungchul Jung, Sang Joon Kim, Mingoo Seok, "A 6.3-Nanowatt-per-Channel 96-Channel Neural Spike Processor for a Movement-Intention-Decoding Brain-Computer-Interface Implant," *arXiv.org*, 2020, [link](#)
- (24) Dewei Wang, Pavan Kumar Chundi, Sung Justin Kim, Minhao Yang, Joao Pedro Cerqueira, Joonsung Kang, Seungchul Jung, Sangjoon Kim, Mingoo Seok, "Always-On, Sub-300-nW, Event-Driven Spiking Neural Network based on Spike-Driven Clock-Generation and Clock-and Power-Gating for an Ultra-Low-Power Intelligent Device," *arXiv.org*, 2020, [link](#)
- (23) Dongkwun Kim, Mingoo Seok, "A 10-Output Single-Inductor-Multiple-Output DC-DC Buck Converter with 200-pF Integrated Output Capacitors for a Sub-mW Multi-Voltage Domain System-on-Chip," a lecture presentation, SRC TECHCON, Sep, 2020

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- (22) Dewei Wang, Mingoo Seok, "Always-On, Sub-300nW, Event-Driven Spiking Neural Network for an Ultra-Low-Power Intelligent Device," a lecture presentation, SRC TECHCON, Sep, 2020
- (21) Peiye Liu, Bo Wu, Huadong Ma, Pavan Kumar Chundi, Mingoo Seok, "MemNet: Memory-Efficiency Guided Neural Architecture Search with Augment-Trim learning," arXiv.org, 2019, [link](#)
- (20) Sung Justin Kim, Mingoo Seok, "A 0.5-1V Input Event-Driven Multiple Digital Low-Dropout-Regulator System for Supporting a Large Digital Load," a lecture presentation, SRC TECHCON, Sep, 2019
- (19) Mingoo Seok, "AI and ML Hardware for Resource-Constrained Devices," poster, TinyML Submit, Santa Clara, CA USA, Mar., 2019
- (18) Peiye Liu, Wu Liu, Huadong Ma, Tao Mei, Mingoo Seok, "KTAN: Knowledge Transfer Adversarial Network," arXiv.org, 2018, [link](#)
- (17) 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," a lecture presentation, SRC TECHCON, Aug, 2018
- (16) 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
- (15) 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](#)
- (14) Saarthak Sarup, Mingoo Seok, "Dynamic Capacity Estimation in Hopfield Networks," arXiv.org, 2017, [link](#)
- (13) 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
- (12) Mingoo Seok, Minhao Yang, Zhewei Jiang, Tianchan Guan, "Machine Learning with Constrained Resources," *IBM / IEEE CAS EDS Symposium*, Sep. 2017
- (11) 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
- (10) 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
- (9) Tianchan Guan, Xiaoyang Zeng, Mingoo Seok, "Recursive Binary Neural Network Learning Model with 2.28b/Weight Storage Requirement," arXiv, 2017, [link](#)
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- (4) Daniel Marti, Mattia Rigotti, Mingoo Seok, Stefano Fusi, "Energy-efficient neuromorphic classifiers," arXiv, 2015, [link](#)
- (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, Technology Transfer, and Commercialization

Technology Transfer and Commercialization

- (5) Advisor, ANAFLASH, Sep. 2020 - present
- (4) Advisor, VITCON, July 2019 - present
- (3) ZSS Microsystem: Zhewei Jiang (Ph.D. student), Prof. Jae-sun Seo (Arizona State University), and I have explored a start-up opportunity to commercialize an in-memory-computing SRAM based microcontroller, Oct. 2019 - Apr. 2020
- (2) Licensing chips, board, and design database for hybrid analog and digital computers to Sendyne, 2018-present
- (1) Licensing multiple sub-milliwatt and sub-microwatt circuits intellectual properties to Ambiq Micro, 2012-2020. In 2020, Ambiq acquired the patents.

Patents

All the pending and approved patents can be searched in [this page](#).

- (13) Mingoo Seok, Zhewei Jiang, Jae-sun Seo, Shihui Yin, "Circuits and Methods for In-Memory Computing," WO/2020/139895, PCT/US2019/068495, 62/784,636 24.12.2018 US, *pending*

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- (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 Justin 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
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- (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

- (76) IDEC (IC Design Education Center) Congress, Daejeon, Republic of Korea, "Recent Advances in AI/ML Hardware," July., 2020, *Plenary talk*
- (75) Rice University, "Enabling Artificial Intelligence in an Internet-of-Thing Device," Feb., 2020

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- (74) University of California Los Angeles, "Enabling Artificial Intelligence in an Internet-of-Thing Device," Nov., 2019
- (73) Massachusetts Institute of Technology (MIT), "Enabling Artificial Intelligence in an Internet-of-Thing Device," Nov., 2019
- (72) International Workshop on Highly Efficient Neural Processing (HENP), in conjunction with ESWEEK 2019, "Sub-Milliwatt and Sub-Microwatt Hardware Architecture for Embedded Intelligent Systems," Oct., 2019
- (71) Arizona State University, "Emerging Deep Learning Chip Architecture" Oct., 2019
- (70) Chey Institute for Advanced Study (CIAS) Scientific Innovation Conference 2019, "Emerging Chip Architecture for Deep Learning," Aug., 2019
- (69) Seoul National University, "Emerging Deep Learning Chip Architecture" Aug., 2019
- (68) Samsung Electronics, Memory Business, 2019, "Recent Hardware Advances for Accelerating Deep Learning," Aug., 2019
- (67) Samsung Research, "Ultra-Low-Power Computing Hardware Design in the Era of AI and ML," Jun., 2019
- (66) Korea Smart Factory Development Conference, Seoul, South Korea, "Smart Factory for Small and Medium Enterprises," Jun., 2019, *Plenary talk*
- (65) Semiconductor Research Corporation (SRC) TxACE eSeminar, "EDAC and DCDC-Converter Co-Design for Addressing Robustness Challenges in Emerging Architecture," Dallas, TX USA, May, 2019
- (64) Workshop on Energy-Secure System Architectures (ESSA), in conjunction with the 12-th IEEE International Symposium on Hardware Oriented Security and Trust (HOST 2019), McLean, VA USA, "Blacklist Core: Machine-Learning Based Dynamic Operating-Performance-Point Blacklisting for Mitigating Power-Management Security Attacks," May, 2019
- (63) Maryland College Park Circuit and Systems (CAS) Chapter, "Ultra-Low-Power Computing Hardware Design in the Era of AI and ML," May, 2019
- (62) AI Edge Workshop on Solid-State Circuits: from Memory to Computation, National Tsing Hua University, Hsinchu, Taiwan, "Cases for Analog Mixed Signal Computing Integrated Circuits for Deep Neural Networks," Apr. 2019
- (61) International Symposium on VLSI Design, Automation, and Test (VLSI-DAT), Special Session, Hsinchu, Taiwan, Cases for Analog Mixed Signal Computing for Deep Neural Networks, Apr, 2019
- (60) National Chiao Tung University, Institute of Electronics, Hsinchu, Taiwan, "Ultra-Low-Power Computing Hardware Design in the Era of AI and ML," Apr. 2019
- (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, Coopertino, CA, US, "Recent Advances in AI and ML Hardware Design," Mar., 2019

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- (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 Innovation, 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

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- (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) Massachusetts Institute of Technology (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
- (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

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- (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

Services

| <u>Activity</u> | <u>Beginning</u> | <u>Ending</u> |
|--|------------------|---------------|
| Computer Engineering Program Committee, Member | 2012 | present |
| EE Computing Labs Committee, Chair | 2018 | present |
| EE Teaching Labs Committee, Member | 2018 | present |
| EE PhD Monitoring and Advising, Member | 2020 | present |
| EE Ext. Comm. and Website, Member | 2020 | present |
| EE Distinguished Lecture Committee, Member | 2018 | 2019 |
| EE Computing Committee, Chair | 2013 | 2017 |

Professional Services

Editorial work

- (6) Associate Editor - IEEE Solid-State Circuits Letters (SSCL), 2017-present

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- (5) Associate Editor - IEEE Transactions on Very Large Scale Integration (VLSI) Systems, 2015-present
- (4) Guest Editor - IEEE Journal of Solid-State Circuits (JSSC), the special issue of 2019 IEEE International Solid-State Circuits Conference (ISSCC), 2019
- (3) Guest Editor - IEEE Solid-State Circuits Letter (SSCL), 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

- (16) Program committee, member, TinyML Research Symposium, 2021-present
- (15) Technical program committee, member, Digital Circuits (DCT), IEEE International Solid-State Circuits Conference (ISSCC), 2019-present
- (14) Technical program committee, member, Emerging Models of Computation (DES5), ACM/IEEE Design Automation Conference (DAC), 2020-present
- (13) Technical program committee, member, DAC Late Breaking Results, ACM/IEEE Design Automation Conference (DAC), 2020-present
- (12) Technical program committee, vice chair, Reliability Circuits, IEEE International Reliability Physics Symposium (IRPS), 2021
- (11) Technical program committee, member, Reliability Circuits, IEEE International Reliability Physics Symposium (IRPS), 2018-present
- (10) Technical program committee, member, Student Research Preview (SRP), IEEE International Solid-State Circuits Conference (ISSCC), 2018-2019
- (9) Technical program committee, member, Power Management, IEEE Custom Integrated Circuits Conference (CICC), 2017-2019
- (8) Special Session Co-Organizer, Panels, IEEE Custom Integrated Circuits Conference (CICC), 2018-2019
- (7) Technical program committee member, Digital Circuits and Technology, ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED), 2013-2018
- (6) Student Design Contest Co-Chair, ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED), 2013-2014
- (5) Technical program committee member, Subthreshold Circuits - IEEE SOI-3D-Subthreshold Microelectronics Technology Unified Conference (S3S), 2014-2019
- (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

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- (1) Technical program committee member, Digital Design, IEEE/ACM International Conference on VLSI Design (VLSID), 2013, 2016, 2017

Workshop, Forum, Panel Organizations

- (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

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- (1) Columbia University Office of the Executive Vice President for Research

Faculty Promotion Evaluation

- (1) University of Macao, School of Microelectronics, 2020

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

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> |
|--|------------------|---------------|
| Korea Advanced Institute of Science and Technology | July 2019 | Jan. 2020 |
| Vitcon | Jun. 2017 | present |
| TexasLDPC | Jul. 2015 | Dec. 2015 |

Thesis Supervised

Summary

| | <u>Total</u> | <u>Completed</u> | <u>In Progress</u> |
|-----------------|--------------|------------------|--------------------|
| B.S. | 7 | 6 | 1 |
| M.S. | 41 | 41 | 0 |
| <u>Doctoral</u> | | | |
| As Supervisor: | 22 | 7 | 15 |
| As Reader: | 27 | 23 | 4 |

Doctoral Thesis, Supervisor

- (21) Yunze Yang, Side-channel attack resiliency, Sep/2021-Aug/2026 (estimated)
- (20) Yuepeng Fan, Resilient processor architecture, Sep/2021-Aug/2025 (estimated)
- (19) Jeongwook Lee, Communication systems hardware, Sep/2021-Aug/2026 (estimated)
- (18) Mao Li, Ultra-low latency network interface, Jan/2021-Dec/2025 (estimated)
- (17) Yunran Zhou, Neuromorphic hardware architecture, Sep/2021-Aug/2025 (estimated)
- (16) Zhaoqing Wang, AI-assisted power management hardware, Sep/2020-Aug/2024 (estimated)
- (15) Chuan-Tung Lin, AI-capable microcontroller architecture, Sep/2020-Aug/2025 (estimated)

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- (14) Paul Huang, Hybrid continuous discrete computing, Jan/2020-Jan/2024 (estimated)
- (13) Daniel Jang, Silicon photonics wireline circuits; advising, Sep/2019-Sep/2024 (estimated)
- (12) Dewei Wang, Neuromorphic, event-driven hardware architecture; advising, Jan/2019-Jan/2023 (estimated)
- (11) Ashish Shukla, Super-conducting digital mixed-signal circuits; advising, Jan/2019-Jan/2023 (estimated)
- (10) Bo Zhang, In-memory computing hardware for AI; advising, Sep/2018-Sep/2023 (estimated)
- (9) Dongkwun Kim, Integrated power converter and load codesign; advising, Sep/2017-Sep/2021 (estimated)
- (8) Teng Yang, co-advising with Prof. Peter R. Kinget, Jan. 2012-present
 - Columbia publications: Journal: 3, Conf. 7
 - Dissertation title: (Tentative) Miniaturized and Voltage Scalable Sensors for On-Chip Thermal and Reliability Management
 - First employment: Intel Advanced Design Group, Yang is currently maintaining the M&F status, working on the dissertation and thesis defense.
- (7) Pavan Kumar Chundi, On-chip machine learning; advising, Sep/2016-Apr/2021
 - Columbia publications: Journal: 3, Conf. 6
 - Dissertation title: Algorithm Hardware Co-Design of Neural Networks for Always-On Devices
 - First employment: Nvidia, Design Methodology Group
- (6) Sung Justin Kim, Integrated and distributed regulators; advising, Jan/2017-Dec/2020
 - Columbia publications: Journal: 6, Conf.: 7
 - Dissertation title: [Integrated and Distributed Digital Low-Drop-Out Regulators with Event-Driven Controls and Side-Channel Attack Resistance](#)
 - First employment: Apple, Silicon Engineering Group
- (5) Zhewei Jiang, Sep/2015-May/2020
 - Columbia publications: Journal: 5, Conf.: 12
 - Dissertation title: [Algorithm-Hardware Co-Design For Local/Edge Computing](#)
 - First employment: Bell Labs
 - Awards: i) Wei Family Private Foundation Fellowship (2015-2020); ii) Mater of Science Award of Excellence (2015); iii) William L. Everitt Student Awards of Excellence (2013)
- (4) Joao Pedro Cerqueira, Sep. 2014-Aug. 2019
 - Columbia publications: Journal: 5, Conf. 9
 - Dissertation title: [Ultra-Low Leakage, Energy Efficient Digital Integrated Circuit and System Design](#)
 - First employment: Apple Silicon Engineering Group
 - Awards: i) 2017 Qualcomm Innovative Fellowship; ii) 2015-2018 Lemann Foundation Fellowship; iii) 2014-2018 Science without borders doctoral fellowship
- (3) Doyun Kim, advising, Sep. 2013-Dec. 2018
 - Columbia publications: Journal: 5, Conf. 7

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- Dissertation title: [Fully Integrated Digital Low Drop-Out Regulator Design based on Event-Driven PI Control](#)
 - First employment: Facebook Hardware Design Labs
- (2) Jiangyi Li, advising, Jan. 2013-Apr. 2018
- Columbia publications: Journal: 5, Conf. 9
 - Dissertation title: [Very-Large-Scale-Integration Circuit Techniques in Internet-of-Things Applications](#)
 - First employment: Apple Silicon Engineering Group
 - Awards: i) Tesla Scholarship
- (1) Seongjong Kim, advising, Jan.2012-Dec.2016
- Columbia publications: Journal: 6, Conf. 10
 - Dissertation title: [Variation-Tolerant and Voltage-Scalable Integrated Circuits Design](#)
 - First employment: Intel Circuit Research Labs (CRL)
 - Awards: i) Catalyst Foundation Student, ii) IEEE SSCS Student Travel Grant

B.S. Thesis and Research Supervising

- (7) Austin Ebel, AI hardware, May/2021-present
- (6) Jay Mok, In-DRAM computing, 2019
- (5) Saarthak Sarup, Neural network memory capacity, 2018, Ph.D. student in Stanford Univ.
- (4) Harrison Liew, FPGA chip architecture, 2017, Ph.D. student 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

- (41) Ayushparth Sharma, MS, Ultra-low-power and resilient microprocessor; Sep/2019-May/2021
- (40) Yunran Zhou, MS, Neuromorphic event-driven hardware architecture, Jan/1/2021-Aug/30/2021
- (39) Wenrui Zhang, MS, Brain computer interface system design, Dec/31/2020
- (38) Yidong Jian, MS, Multi-core microcontroller architecture, Dec/31/2020
- (37) Xiaofu Pei, MS, In-memory computing circuits, Dec/31/2020
- (36) Yi Zhang, MS, Advanced EDAC technique, Nov/15/2020
- (35) Yuchan Hsueh, MS, Power management IC with security features, Dec/31/2019
- (34) Paul Huang, MS, Hybrid Continuous Discrete Computing, Dec/31/2019
- (33) Xuyang Liu, MS, Hybrid Continuous Discrete Computing, Dec/31/2019
- (32) Dewei Wang, Neuromorphic event-driven hardware architecture, 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

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- (27) Varun Ahalawat, In-DRAM computing, 2018, Qualcomm
- (26) Blayne Kettlewell, Custom FPGA design and implementation, 2017, Magnetic Ins.
- (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, As Reader (On Thesis Committee)

Columbia Ph.D. Thesis Committee

- (27) Yudong Zhang (Kinget's group), Committee, Design of Power-Efficient Optical Transceivers and Design of High-Linearity Wireless Wideband Receivers, Apr. 2021
- (26) Nathan C. Abrams (Bergman's group), Committee, Development of Silicon Photonic Multi Chip Module Transceivers, Jul. 2020
- (25) Shravan Nagam (Kinget's group), Committee, High Performance Sub-Sampling Phase Detector based Ring-Oscillator PLLs, Feb. 2020
- (24) Chengrui Le (Kinget's group), Committee, Design Techniques for Highly Integrated Hybrid-Switched-Capacitor-Resonant PowerConverters for LED Lighting Applications, Feb. 2020

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- (23) Sarthak Kalani (Kington's group), Committee, Voltage and Time-Domain Analog Circuit Techniques for Scaled CMOS Technology., Oct. 2019
- (22) Vivek Mangal (Kington's group), Committee, Energy-Detecting Receivers for Wake-Up Radio Applications, Sep. 2019
- (21) Zheng Shou (Chang's group), Committee, Deep Learning for Action Understanding in Video, Apr. 2019
- (20) Andrea Lottarini (Kim's group), Committee, Design Space Exploration of Accelerators for Warehouse Scale Computing, 2019, Google
- (19) Kevin Tien (Shepard's group), Committee, Integrated Inductor based DCDC Converter, 2018, IBM
- (18) Linxiao Zhang (Krishwanamy's group), RF/Analog Spatial Equalization for Integrated Digital MIMO Receivers, 2017
- (17) Jeffrey Chuang (Krishwanamy's group), RF Mixed-signal Phase-Locked Loop (PLL) for Broad-band radio, 2017
- (16) Jahnavi Sharma (Krishwanamy's group), CMOS Synthesizers for Emerging RF-to-Optical Applications, 2017
- (15) Ning Guo (Tsividis's group), Investigation of Energy-Efficient Hybrid Analog Digital Approximate Computation in Continuous Time, 2016, Startup
- (14) Yu Chen (Tsividis's group), Digital Signal Processing with Signal-Derived Timing: Analysis and Implementation, 2016, Apple
- (13) Sharvil Patil (Tsividis's group), Energy-Efficient Time-based Encoders and Digital Signal Processors in Continuous Time, 2016, Analog Devices
- (12) Fabio Carte (Kymissis's group), Low Temperature Monolithic Integration for Silicon and Organic Electronics, 2015, IBM TJ Watson
- (11) Chun-Wei Hsu (Kington's group), Challenges and Solutions for High Performance Analog Circuits with Robust Operation in Low Power Digital CMOS, 2015, Analog Dev.
- (10) Jayanth Kuppambatti (Kington's group), Mixed-Signal Design Techniques in Scaled CMOS, 2014, Startup
- (9) Christos Vezyrtzis (Tsividis's group), Continuous Time DSP, 2013, IBM TJ Watson
- (8) John Sarik (Kymissis's group), Systems for Pervasive Electronics and Interfaces, 2013

Visiting Ph.D. Students

- (7) Pangi Park (Cho's group), visiting Ph.D. student, Korea Advanced Institute of Science and Technology (KAIST), Jan/1/2021-June/30/2021 (estimated)
- (6) Peiye Liu, visiting Ph.D. student, BUPT, Memory-efficient neural architecture search, 2017-2019
- (5) Tianchan Guan (Zeng's group), visiting Ph.D. student, Fudan University, Scalable synaptic memory model, 2015-2018, Alibaba
- (4) Wei Jin (W. He's group), visiting Ph.D. student, Shanghai Jiao Tong University, Ultra-low voltage sequencing circuits, 2014-2016, Huawei

Remote Ph.D. Students Advising

- (3) Manho Kim (H.J. Lee's group), Ph.D., Seoul National University, In-memory-computing DRAM architecture, 2018-2023 (estimated)

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- (2) Chuxiong Lin (W. He's group), Ph.D., Shanghai Jiao Tong University, Ultra-low-power digital circuits, 2018-2023 (estimated)
- (1) Jin-O Seo (S.H. Cho's group), Ph.D., KAIST, Analog-mixed-signal computing, 2018-2023 (estimated), also a visiting student for Feb/2020-May/2019

Postdoctoral Associates

- (6) Jonghyun Oh, Postdoctoral Research Scientist, Ph.D. from Seoul National University, Sep/15/2021-Sep/14/2023 (estimated)
- (5) Min-Seong Choo, Postdoctoral Research Scientist, Ph.D. from Seoul National University, Dec/1/2020-Nov/30/2022 (estimated)
- (4) Soobong Jang, Visiting Research Professor, Mar.2019-Apr.2020, Director, Samsung Electronics, Suwon, Republic of Korea
- (3) Hyuk-jae Lee, Visiting Senior Research Scientist, Sep.2018-Dec.2018, Professor, Seoul National University, Seoul, Republic of Korea
- (2) Weiwei Shan, Visiting Associate Research Scientist, 2017-2019, currently Associate Professor, Southeast University, Nanjing, China
- (1) Minhao Yang, Postdoctoral Research Scientist, 2016-2018, currently Scientist, EPFL, Lausanne, Switzerland

Current Research Group

- (15) Min-Seong Choo, Postdoctoral Research Scientist, Ultra-low latency silicon-photonics network interface, Dec/1/2020-Nov/30/2022 (estimated)
- (14) Jonghyun Oh, Postdoctoral Research Scientist, Cryogenic, ultra-low-power neural network accelerator, Sep/15/2021-Sep/14/2023 (estimated)
- (13) Dongkwun Kim, PhD, Integrated power converter and load codesign; advising, Sep/2017-Sep/2021 (estimated)
- (12) Ashish Shukla, PhD, Super-conducting digital mixed-signal circuits; advising, Jan/2019-Jan/2023 (estimated)
- (11) Bo Zhang, MS/PhD, Mixed-signal AI hardware; advising, Sep/2018-Sep/2023 (estimated)
- (10) Dewei Wang, PhD, Neuromorphic, event-driven hardware architecture; advising, Jan/2019-Jan/2023 (estimated)
- (9) Daniel Jang, MS/PhD, Analog/digital computing hardware; advising, Sep/2019-Sep/2024 (estimated)
- (8) Paul Huang, PhD, Hybrid continuous discrete computing, Jan/2020-Jan/2024 (estimated)
- (7) Zhaoqing Wang, PhD, AI-assisted power management hardware, Sep/2020-Aug/2024 (estimated)
- (6) Chuan-Tung Lin, MS/PhD, AI-capable microcontroller architecture, Sep/2020-Aug/2025 (estimated)
- (5) Mao Li, MS/PhD, Ultra-low latency network interface, Jan/2021-Dec/2025 (estimated)

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- (4) Yunze Yang, MS/PhD, Side-channel attack resiliency, Sep/2021-Aug/2026 (estimated)
- (3) Yuepeng Fan, PhD, Resilient processor architecture, Sep/2021-Aug/2025 (estimated)
- (2) Jeongwook Lee, MS/PhD, Communication systems hardware, Sep/2021-Aug/2026 (estimated)
- (1) Teng Yang, PhD, Area-efficient on-chip thermal and aging monitoring; co-advising with Prof. Peter R. Kinget, 2012-2019 (estimated), on M&F and working in Intel

Teaching Experience

At Columbia University

| Term | Subject Number | Title | Role |
|-------------|----------------|--------------------------------------|----------|
| 2021 Fall | CSEEW4823 | Advanced Logic Design | Lecturer |
| 2021 Spring | EECSE6321 | Advanced Digital Electronic Circuits | Lecturer |
| 2020 Fall | CSEEW4823 | Advanced Logic Design | Lecturer |
| 2020 Spring | EECSE6321 | Advanced Digital Electronic Circuits | Lecturer |
| 2019 Fall | CSEEW4823 | Advanced Logic Design | Lecturer |
| 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 |

Outside Columbia University

Short courses (weeks to a month)

- (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 (μ W and sub- μ 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

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- (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

Tutorials (less than a day)

- (7) On-Chip Interconnects: Basic Concepts, Designs, and Future Opportunities by Yvain Thonnart (CEA-LIST), Coordinator, 2 hour tutorial, IEEE International Solid-State Circuits Conference (ISSCC), San Francisco, CA, USA, Feb., 2021
- (6) Analog-Mixed-Signal Computing (AMS) Hardware, two one-hour lectures in 2020 Korea Advanced Institute of Science and Technology (KAIST) E-Seminar, July, 2020
- (5) Basics of Digital Low-Dropout (LDO) Integrated Voltage Regulators, two one-hour lectures in 2020 Korea Advanced Institute of Science and Technology (KAIST) E-Seminar, July, 2020
- (4) Basics of Digital Low-Dropout (LDO) Integrated Voltage Regulators, 2 hour tutorial in IEEE International Solid-State Circuits Conference (ISSCC), San Francisco, CA, USA, Feb., 2020
- (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

- (12) Seoul Science High School, "Enabling AI in an IoT Device," Oct., 2019
- (11) Seoul Science High School, "The Future of AI is Small," Oct., 2018

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- (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