

Kye-Shin Lee

Work Address:

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Career Objective

Contribute in research and teaching for the area of analog and mixed signal integrated circuit design

Current Position (since Aug. 2016)

- THE UNIVERSITY OF AKRON, Akron, OH
Associate Professor, Department of Electrical & Computer Engineering

Research Interest

- Analog & Mixed Signal Integrated Circuits
- Low power & High Speed Analog-to-Digital Converters & Digital-to-Analog Converters
- Display Drivers & Touch Sensors
- Circuit and System Modeling, Characterization, and Testing

Education

- **Ph.D. in Electrical Engineering**, University of Texas at Dallas, Richardson, TX, Aug. 2005
Dissertation: A 2-channel time-interleaved 2nd order $\Sigma\Delta$ modulator in 0.18um CMOS
Advisor: Professor Franco Maloberti
- **M.S. in Electrical Engineering**, Texas A&M University, College Station, TX, Aug. 2002
Thesis: A 1.8V 2-2 cascade sigma-delta modulator for high speed applications
- **B.S. in Electrical Engineering**, Korea University, Seoul, Korea, Feb. 1992

Professional Experience

- Jan. 2010 – Aug. 2016: Department of Electrical & Computer Engineering, The University of Akron
Assistant Professor
- Feb. 2009 – Dec. 2009: Dept. of Electronics, Sun Moon University, Korea
Assistant Professor
- Aug. 2005 – Jan. 2009: Texas Instruments Inc., Dallas, TX
- Jan. 1994 – Oct. 1999: LG Semicon Co., Ltd. (now Hynix Semicon Inc.), Seoul, Korea

Classes Taught

- Physical Electronics (Junior level)
- Electronic Design (Junior level)
- VLSI Design (Junior level)
- VLSI Circuits and Systems (Senior/1st year Graduate level)
- Analog IC Design, Senior/1st year Graduate level
- Analog Signal Processing Circuits and Systems (Graduate level)
- Data Converters (Graduate level)
- Biomedical Circuits and Sensors (Graduate level)

Membership

- IEEE Circuits and Systems (CAS) Society, Member 2001 - present
- Korean-American Scientists and Engineers Association (KSEA), Member 2002 - present

Graduate Students Directed (year graduated)

- **PhD (2)**
Zaniar Hoseini (Aug. 2018), now with *Panasonic Device Solution Lab., Marlborough, MA*
Mohammadreza Asgari (Dec. 2018), now with *Marvell Semiconductor Inc., Santa Clara, CA*
- **MS (25)**
Nikhil Reddy Karnati (Aug. 2011), Ravi Shankar Gaddam (Dec. 2012), Md. Naimul Hasan (Dec. 2012), Kripesh Battarai (Co-advised, Dec. 2012), Pongpachara Limpisathian (Co-advised, Dec. 2013), Shivasai Bethi (Dec. 2014), Vaishnavi Maduri (Aug. 2015), Nivethithaa Ravikumar (Aug. 2015), Shiva Cheggoju (Dec. 2015), Teja Nagavalli (Dec. 2015), Bo Liu (Dec. 2016), Guanglei Zhang (Dec. 2017), Abdullah Kurtoglu (Co-advised, Dec. 2017), Srikar Naini (Aug. 2018), Joseph Duah (Dec. 2018), Padmini Lala (Dec. 2018), Lakshmi Mudragada (Dec. 2019), Sai Krishna Gullapalli (Dec. 2019), John Vorhies (May 2020), Alireza Bagheri (Dec. 2020), Md Billal Hossain (Co-advised, May 2020), Kishankumar Patel (May 2020), Ravi Teja Mannem (Aug. 2021), Sainath Samireddy (Dec. 2021), Israel Koiku (Dec. 2022)
- **In progress**
1-PhD and 1-MS.

Awards

- Firestone Research Initiative Award for Versatile Sensor Platform Development, May 2012

Service Work

- Associate Editor, Journal of Multimedia Information Systems
- Technical Paper Reviewer for IEEE Journal of Solid State Circuits (JSSC), IEEE Transaction on Circuits and Systems I, II (TCAS-I, TCAS-II), IEEE Transaction on Instrumentation and Measurement
- ABET coordinator and undergraduate advisor at Dept. of ECE, University of Akron

Funded Proposals

1. NIH: Fully analog motion artifact elimination circuit for compact and low power A-ECG devices, PI : Kye-Shin Lee, \$146,800, 2021

2. NSF I-Corps: **Nylon-11 nanowire based piezoelectric energy harvester for smart tire sensors**, PI : Kye-Shin Lee, \$50,000, 2021
3. Faculty Research Committee Fellowship: Linearized transistor model based analog integrated circuit design methodology, PI : Kye-Shin Lee, \$10,000, 2020
4. NSF I-Corps: Smart phone accessible low cost water condition sensor, PI : Kye-Shin Lee, \$50,000, 2014
5. ODOOD-TVSF (Phase-I): Smart phone based universal water quality sensor, PI: Kye-Shin Lee, Co-PI: Ajay Mahajan, \$50,000, 2013
6. Cantis Grant: Development of EEG and ECG sensing circuits, PI: Kye-Shin Lee, \$49,500, 2015
7. i2v Grant: Development of non-invasive blood glucose sensor, PI: Kye-Shin Lee, Co-PI: Yilmaz Sozer, \$30,000, 2014
8. LEAP: Smart integrated water quality sensor, PI: Kye-Shin Lee, \$10,000, 2015
9. Firestone Research Initiative Grant: Time-voltage mixed mode signal processing circuits for versatile sensor platforms, PI: Kye-Shin Lee, \$10,000, 2012
10. ODOOD-IPP: Smart sensors and sensor system design and commercialization, PI: De Abreu-Garcia, Co-PI: Kye-Shin Lee and 6 other faculty, \$1,744,192, 2014
11. ODOOD-WCSSE (Phase-II): Clean technology sensors support for Ohio companies to add value to their products and help move them to the market place at an accelerated pace, PI: De Abreu-Garcia, Co-PI: Iqbal Husain and Kye-Shin Lee, \$316,672, 2011

Publications

Journal Papers:

1. M. Asgari, **K. S. Lee**, and H. Chung "Highly area efficient component sharing extended ADC for multi-channel sensing," *IEEE Trans. on Circuits and Systems-II*, vol. 70, pp. 889-893, Mar. 2023.
2. **K. S. Lee**, "Macro-model for discrete-time sigma-delta modulators," *Electronics*, vol. 11, 3994, Dec. 2022
3. M. Lacek, D. Nahra, B. Roter and **K. S. Lee**, "Linearized transistor model automated biasing scheme for analog integrated circuits," *J. Multimedia Info. Sys.*, vol. 8, pp. 143-146, Jun. 2021.
4. Z. Hoseini, M. Nazari, **K. S. Lee** and H. Chung, "Current feedback instrumentation amplifier with built-in differential electrode offset cancellation loop for ECG/EEG sensing frontend," *IEEE Trans. Instrum. Meas.*, vol. 70, pp. 1-11, 2021, Art no. 2001911.
5. Z. Hoseini, **K. S. Lee**, and C. K. Kwon, "Design of an 8-bit time-mode cyclic ADC based on macro modeling," *Int. J. Circ. Theor. Appl.* vol. 48, pp. 1839-1852, 2020.
6. M. Nazari, A. Bagheri and **K. S. Lee**, "Fully analog ECG baseline wander tracking and removal circuitry using HPF based R-peak detection and quadratic interpolation," *J. Multimedia Info. Sys.*, vol. 7, pp. 231-237, Sept. 2020.
7. M. Asgari and **K. S. Lee**, "Fully-integrated CMOS electrical conductivity sensor for wet media," *IEEE Sensors J.*, vol. 19, no. 15, pp. 6445-6451, Aug. 2019.
8. M. Vu, N. H. Tran, D. G. Wijeratne, K. Pham, **K. S. Lee**, and D. H. Nguyen, "Optimum signaling schemes and capacity of non-coherent rician fading channels with low resolution output quantization," *IEEE Trans. Wireless Commun.*, vol. 18, no. 6, pp. 2989-3004, Jun. 2019.
9. L. K. Mudragada, **K. S. Lee**, and B. G. Kim, "Virtual prototyping of area based image stitching algorithm," *J. Multimedia Info. Sys.*, vol. 6, pp. 7-14, Mar. 2019.

10. T. Nagavalli, S. J. Lee, **K. S. Lee**, "Smart water quality sensor platform for hydroponic plant growing applications," *J. Multimedia Info. Sys.*, vol. 5, pp. 215-220, Sept. 2018.
11. S. J. Lee, **K. S. Lee**, and B. G. Kim, "Binary image based fast DoG filter using zero dimensional convolution and state machine LUTs," *J. Multimedia Info. Sys.*, vol. 5, pp. 131-137, Jun. 2018.
12. M. Asgari, **K. S. Lee**, and Y. M. Lee, "Touch sensor readout circuit with comparator threshold self-adjustment," *IEICE Electronics Express*, vol. 15, no. 1, pp. 1-12, Jan. 2018.
13. D. Tekgun, W. Uddin, **K. S. Lee**, and Y. Sozer, "Real-time high frequency impedance monitoring of human skin through magnetic coupling," *IEEE Sensors J.*, vol. 17, no. 19, pp. 6167-6174, Oct. 2017.
14. Z. Hoseini, **K. S. Lee**, H. Chung, Y. J. Song, "2-channel EEG sensor frontend for portable health condition monitoring applications," *J. Low Power Electron*, vol. 13, no. 2, pp.240-248, Jun. 2017.
15. Y. M. Lee, **K. S. Lee**, and T. Jeong, "A compact low-power shunt proximity touch sensor and readout for haptic function," *J. of Semiconductor Technology and Science*, vol. 13, pp. 380–386, Jun. 2016.
16. J. G. Hong, H. Chung, B. G. Kim, and **K. S. Lee**, "Implementation of 21:9 cinema mode function using two ICs supporting full HD resolution," *Displays*, vol. 40, pp. 53-61, 2015.
17. Z. Hoseini, J. Abdekhoda, and **K. S. Lee**, "An ultra low voltage low power self biased latched comparator with wide input common mode range for biomedical applications," *J. of Circuits, Systems, and Computers*, vol. 24, no. 9, 2015.
18. B. Liu, Z. Hoseini, **K. S. Lee**, and Y. M. Lee, "On-chip touch sensor readout circuit using passive sigma-delta modulator based capacitance-to-digital converter," *IEEE Sensors J.*, vol. 15, no. 7, pp. 3893-3902, July 2015.
19. Md. N. Hasan and **K. S. Lee**, "A wide linear output range bio-potential amplifier for physiological measurement frontend," *IEEE Trans. Instrum. Meas.*, vol. 64, no. 1, pp. 120-131, Jan. 2015.
20. N. J. Blasdel, E. K. Wujcik, J. Carlette, **K. S. Lee**, and C. N. Monty, "Fabric nanocomposite resistance temperature detector," *IEEE Sensors J.*, vol. 15, no. 1, pp. 300-306, Jan. 2015.
21. R. S. Gaddam and **K. S. Lee**, "A 10-Bit dual-plate sampling DAC with capacitor reuse on-chip reference voltage generator," *Microelectronics Journal*, vol. 44, pp. 511–518, Jun. 2013.
22. M. Vatani, Y. Lu, **K. S. Lee**, H. C. Kim, and J. W. Choi, "Direct-write stretchable sensors using single-walled carbon nanotube/polymer matrix," *ASME Journal of Packaging*, vol. 135, pp. 1-5, Mar. 2013.
23. H. Y. Park, S. H. Yang, S. Kim, **K. S. Lee**, and Y. M. Lee, "A touch sensor readout circuit using switched-capacitor charge pump," *IEICE Electronics Express*, vol. 9, no. 13, pp. 1090-1095, July 2012
24. H. Y. Park, S. H. Yang, S. Kim, **K. S. Lee**, and Y. M. Lee, "A parasitic insensitive C-DAC with time-mode reference voltage generator," *IEICE Electronics Express*, vol. 9, no. 8, pp. 745-751, April 2012
25. S. H. Yang, **K. S. Lee**, S. Kim, and Y. M. Lee, "A switched-capacitor PWM generator for LCD backlight brightness control," *IEICE Electronics Express*, vol. 8, no. 11, pp. 842-847, Jun. 2011.
26. S. H. Yang, **K. S. Lee**, S. Kim, and Y. M. Lee, "Charge-redistribution DAC with double bit processing in single capacitor," *Electronics Letters*, vol. 47, no. 5, pp. 312 – 313, March 2011
27. S. H. Yang, S. Kim, **K. S. Lee**, and Y. M. Lee "A design of 8-bit cyclic DAC with mismatch compensation of capacitors," *Trans. KIEE (ISSN: 1975-8359)*, vol. 60, no. 2, pp. 315-319, Feb. 2011
28. **K. S. Lee** and Y. M. Lee, "Switched-capacitor cyclic DAC with mismatch charge compensation," *Electronics Letters*, vol. 46, no. 13, pp. 902-903, Jun. 2010
29. Y. M. Lee and **K. S. Lee**, "Characterization of cyclic digital-to-analog converter for display data driving," *IEEK Journal (ISSN: 1229-6392)*, vol. SC-47, no. 3, pp. 13-18, May 2010

30. **K. S. Lee**, "Mixed CT/DT cascaded sigma-delta modulator," *J. of Semiconductor Technology and Science*, vol. 9, pp. 233–239, Dec. 2009
31. **K. S. Lee**, S. Kwon, and F. Maloberti, "A power efficient time-interleaved $\Sigma\Delta$ modulator for broadband Applications," *IEEE Journal of Solid State Circuits*, vol. 42, pp. 1206-1215, Jun. 2007
32. **K. S. Lee**, Y. Choi, and F. Maloberti, "Domino free 4-path time-interleaved second order sigma-delta Modulator," *Analog Integrated Circuits and Signal Processing*, vol. 43, pp. 225–235, Jun. 2005
33. **K. S. Lee**, Y. Choi, and F. Maloberti, "SC amplifier and SC integrator with an accurate gain of 2," *IEEE Trans. on Circuits and Systems-II*, vol. 52, pp. 194 -198, April 2005
34. **K. S. Lee** and F. Maloberti, "Time-interleaved sigma-delta modulator using output prediction scheme," *IEEE Trans. on Circuits and Systems-II*, vol. 51, pp. 537-541, Oct. 2004

Conference proceedings:

1. M. Nazari and **K. S. Lee**, "Low power and area efficient fully on-chip ECG motion artifact removal circuitry utilizing band pass filter based R-peak detection scheme," *IEEE MWSCAS*, East Lansing, MI, Aug. 2021, pp. 916-920.
2. M. Akbari, M. Nazari, O. Hashemipour, and **K. S. Lee**, "Energy-efficient and area-efficient switching schemes for SAR ADCs," *IEEE MWSCAS*, Dallas, TX, Aug. 2019, pp. 97-100.
3. M. Nazari and **K. S. Lee**, "Fully analog baseline wander elimination circuit for real-time ambulatory ECG recording," *IEEE MWSCAS*, Dallas, TX, Aug. 2019, pp. 33-36.
4. Z. Hoseini and **K. S. Lee**, "Compact time-mode SAR ADC with capacitor flipping bit-cycling operation," *IEEE MWSCAS*, Windsor, Canada, Aug. 2018, pp. 404-407.
5. S. R. Samireddy, J. Carletta, and **K. S. Lee**, "An embedded algorithm for gunshot detection," *IEEE MWSCAS*, Boston, MA, Aug. 2017, pp. 68-71.
6. M. Asgari, **K. S. Lee**, and N. Ida, "Highly linear bridge-based ISFET pH sensor readout circuit," *IEEE MWSCAS*, Boston, MA, Aug. 2017, pp. 1049-1052.
7. A. Kurtoglu, J. Carletta, and **K. S. Lee**, "Energy consumption in long-range linear wireless sensor networks using LoRaWan and Zigbee," *IEEE MWSCAS*, Boston, MA, Aug. 2017, pp. 1163-1167.
8. T. Latiff, N. Ida, **K. S. Lee**, and J. Carletta, "A current and vibration based detection system for lightning strikes on transmission towers," *IEEE MWSCAS*, Boston, MA, Aug. 2017, pp. 1272-1275.
9. M. Asgari and **K. S. Lee**, "A single-ended chopper-stabilized ISFET amplifier for continuous pH measurement applications," *IEEE MWSCAS*, Denver CO, Aug. 2015.
10. N. Ravikumar, Z. Hoseini, **K. S. Lee**, S. I. Hariharan, and Y. M. Lee "An area efficient 10-bit time mode hybrid DAC with current settling error compensation," *IEEE MWSCAS*, Denver CO, Aug. 2015.
11. V. Ariyaratna, S. Kulasekera, A. Madanayake, and **K. S. Lee**, "Multi-beam 4GHz microwave apertures using current mode DFT approximation on 65nm CMOS," *IEEE IMS*, Phoenix AZ, May 2015.
12. R. Beak, K. S. Jang, B. G. Kim, and **K. S. Lee**, "Content-awareness based fast block motion estimation algorithm for H.264/AVC encoding system," in *Lecture Notes for Computer Science and Its Application*, Springer, Jan. 2015, pp. 155-161.
13. Y. M. Lee and **K. S. Lee**, "Sigma-delta modulator based capacitive type touch sensor," *KIEE Symposium*, Daejeon, Korea, Dec. 2014, pp.113-114.
14. M. Asgari, V. Maduri, **K. S. Lee**, and A. Mahajan, "Hydroponic water condition sensor using single sensing electrode pair," *KIEE Symposium*, Daejeon, Korea, Dec. 2014, pp.135-138.

15. Z. Hoseini, **K. S. Lee**, and B. G. Kim, "Macro modeling approach for semi-digital smart integrated Circuits," in Lecture Notes for *Frontier and Innovation in Future Computing and Communications*, Springer, Jan. 2014, pp. 289-296.
16. **K. S. Lee**, M. Asgari, and Y. M. Lee, "A reconfigurable switched-capacitor resistor for proximity touch sensor readout circuits," *Euro Display 2013*, London UK, Sept. 2013, pp. 139-143.
17. Z. Hoseini and **K. S. Lee**, "An 8-bit 500kS/s semi-digital cyclic ADC with time-mode residue voltage Generation," *IEEE MWSCAS*, Columbus OH, Aug. 2013, pp. 832-835.
18. S. Bethi, **K. S. Lee**, R. Veillette, J. Carletta, and M. Willett, "A temperature and process insensitive CMOS reference current generator," *IEEE MWSCAS*, Columbus OH, Aug. 2013, pp. 301-304.
19. B. Liu, M. Kollarits, R. Veillette, J. Carletta, and **K. S. Lee**, "A high-temperature comparator with rail-to-rail input voltage range," *IEEE MWSCAS*, Columbus OH, Aug. 2013, pp. 533-536.
20. N. Rajapaksha *et al.*, "Toward RF analog IC realization of wave-discrete filters on 65nm CMOS," *IEEE 27th Conv. of IEEEI*, Nov. 2012, pp. 1-5.
21. G. Zhang and **K. S. Lee**, "SAR ADC using single-capacitor pulse width to analog converter based DAC," *IEEE ISCAS*, Seoul Korea, May 2012, pp. 2365-2368.
22. Y. M. Lee and **K. S. Lee**, "Capacitive type touch sensor readout circuit using passive incremental $\Sigma\Delta$ based C-to-V converter," *Int. Display Workshop (IDW)*, Nagoya, Japan, Dec. 2011, pp. 1361-1362.
23. Y. M. Lee and **K. S. Lee**, "On-chip touch sensor readout circuit using SC charge pump based C-to-V Converter," *Euro-Display 2011*, Bordeaux-Arcachon, France, Sept. 2011.
24. A. Madanayake, N. Rajapaksha, C. Wijenayake, **K. S. Lee**, L. T. Bruton, L. Belostoski, "A new class of spatially-discrete time-continuous 2D IIR filters based on wave digital filter theory," *IEEE Pacific Rim Conference*, Victoria, Canada, Sept. 2011, pp. 685-690.
25. N. R. Karnati, **K. S. Lee**, J. Carletta, and R. Veillette, "A power efficient polyphase sharpened CIC filter for sigma-delta ADCs," *IEEE MWSCAS*, Seoul, Korea, Aug. 2011, pp. 1-4
26. Y. M. Lee and **K. S. Lee**, "LCD backlight controller using passive sigma-delta modulator PWM generator," *Int. Display Workshop (IDW)*, Fukuoka Japan, Dec. 2010, pp. 1659-1660
27. U. Nukala, and **K. S. Lee**, "A Compact current steering DAC with component swapping calibration," *IEEE Circuits and Systems Workshop*, Dallas TX, Oct. 2010, pp. 1-4
28. R. S. Gaddam, **K. S. Lee**, and Y. M. Lee "Parasitic insensitive 10-bit SC DAC for large sized flat panel Displays," *Crystal Valley Conference & Exhibition (CVCE)*, Asan Korea, Oct. 2010, pp. 271-272
29. **K. S. Lee** and Y. M. Lee, "Switched capacitor PWM generator for LCD backlight controllers," *Int. Conf. on Electronics, Information and Communication (ICEIC)*, July 2010, Cebu Philippines, pp. 361-364
30. Y. M. Lee and **K. S. Lee**, "Charge redistribution digital-to-analog converter for large sized flat panel Displays," *Int. Display Workshop (IDW)*, Miyazaki Japan, Dec. 2009, pp. 1553-1554
31. Y. M. Lee and **K. S. Lee**, "A compact cyclic DAC architecture for mobile display drivers," *Int. Meeting on Information Display (IMID)*, KINTEX Korea, Oct. 2009, pp. 1578-1581
32. **K. S. Lee**, H. Kim, and J. S. Park, "Sensitivity analysis of direct conversion receivers to analog-to-digital converter performance," *MWSCAS 2009*, Cancun Mexico, Aug. 2009, pp. 272-275
33. H. Kim and **K. S. Lee**, "Sigma-delta ADC characterization using noise transfer function pole-zero Tracking," *IEEE Int. Test Conf.*, San Jose CA, Oct. 2007
34. **K. S. Lee** and H. Kim, " $\Sigma\Delta$ ADC characterization using NTF pole-zero pattern analysis," *Texas*

Instruments Sym. on Test, Richardson TX, Aug. 2007

35. **K. S. Lee**, S. Kwon and F. Maloberti, "A 5.4mW, 2-channel time-interleaved multi-bit $\Sigma\Delta$ modulator with 80dB SNR and 85dB DR for ADSL," *ISSCC Dig. Tech. Papers*, vol. 49, San Francisco, CA, Feb. 2006, pp. 70-71
36. **K. S. Lee**, Y. Choi and F. Maloberti, "Domino free 4-path second order time-interleaved sigma-delta Modulator," *IEEE Int. Sym. Circuits and Systems*, vol. 1, Vancouver, Canada, May 2004, pp. 473-476
37. **K. S. Lee** and F. Maloberti, "A 1.8V, 1MS/s, 85dB SNR, 2+2 mash $\Sigma\Delta$ modulator with $\pm 0.9V$ reference Voltage," *Symposium on VLSI Circuits Dig. Tech. Papers*, Kyoto, Japan, Jun. 2003, pp. 71-74

Patents:

1. **K. S. Lee** and A. Mahajan, Universal water condition monitoring device, *U.S. Patent No.9851337*, issued Dec. 26, 2017
2. J. W. Choi, E. Engeberg, **K. S. Lee**, and H. C. Kim, Flexible tactile sensors and method of making, *U.S. Patent No.9664717* issued May 30, 2017
3. R. Byrd and **K. S. Lee**, A discrete-time single-amplifier 2nd order delta-sigma ADC, *U.S. Patent No.7564389* issued July 21, 2009
4. **K. S. Lee**, Color signal processing circuit with hue/gain control and frequency conversion mechanisms, *U.S. Patent No.5953059* issued Sept. 14, 1999