

## SEMINAR ANNOUNCEMENT

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING  
COLLEGE OF DESIGN AND ENGINEERING

Website: <https://cde.nus.edu.sg/ece>

**Area: Integrated Circuits & Embedded Systems (ICES)**

**Host: Asst Prof Jang Moonhyung**

<b>TOPIC</b>	:	<b>Towards Monolithic Mobile Ultrasound Imaging System for Medical and Drone Applications</b>
<b>SPEAKER</b>	:	<b>Assoc Prof Jerald Yoo Associate Professor, Department of Electrical and Computer Engineering, Seoul National University</b>
<b>DATE</b>	:	<b>Wednesday, 20 August 2025</b>
<b>TIME</b>	:	<b>3:00PM to 4:30PM</b>
<b>VENUE</b>	:	<b>E1-06-09</b>

### ABSTRACT

Ultrasound Imaging System (UIS) has been widely used in medical imaging with its non-invasive, non-destructive monitoring nature; but so far the UIS has large form factor, making it difficult to integrate in mobile form factor. For drone and robotic vision and navigation, low-power 3-D depth sensing with robust operations against strong/weak light and various weather conditions is crucial. CMOS image sensor (CIS) and light detection and ranging (LiDAR) can provide high-fidelity imaging. However, CIS lacks depth sensing and has difficulty in low light conditions. LiDAR is expensive with issues of dealing with strong direct interference sources. UIS, on the other hand, is robust in various weather and light conditions and is cost-effective. However, in air channel, it often suffers from long image reconstruction latency and low framerate.

To address these issues, this talk introduces UIS ASICs for medical and drone applications. The medical UIS ASIC is designed to transmit pulse and receive echo through a 36-channel 2-D piezoelectric Micromachined Ultrasound Transducer (pMUT) array. The 36-channel ASIC integrates a transmitter (TX), a receiver (RX), and an analog-to-digital converter (ADC) within the 250- $\mu\text{m}$  pitch channel while consuming low-power and supporting calibration to compensate for the process variation of the pMUT. With its small form factor, Intervascular Ultrasound (IVUS) and Intracardiac Echocardiography (ICE) becomes a viable application. The ASIC in 0.18- $\mu\text{m}$  1P6M Standard CMOS is verified with both electrical and acoustic experiments with a 6 $\times$ 6 pMUT array. Also, the ASIC for drone applications generates 28 Vpp pulses in standard CMOS and the digital back-end (DBE) achieves 9.83M-FocalPoint/s throughput to effectively translate real-time 3-D image streaming at 24 frames/s. With an 8 $\times$ 8 bulk piezo transducer array, the UIS ASIC is installed on an entry-level consumer drone to demonstrate 7-m range detection while the drone is flying. The talk will conclude with interesting research directions lying ahead in UIS.

### BIOGRAPHY

Jerald Yoo received the B.S., M.S., and Ph.D. degrees in Department of Electrical Engineering from the Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea, in 2002, 2007, and 2010, respectively. Between 2010 and 2024, he was with Massachusetts Institute of Technology ('10-'11', visiting scholar), Masdar Institute of Science and Technology, Abu Dhabi, UAE (now Khalifa university, '10-'16), and National University of Singapore ('17-'24). Since 2024, he has been with the Department of Electrical and Computer Engineering, Seoul National University, where he is currently an Associate Professor. He has pioneered research on Body-Area Network (BAN) transceivers for communication/powering and wearable body sensor network using the planar-fashionable circuit board for a continuous health monitoring system. His current research interests include biomedical circuits and systems, BAN for communication and powering, and ASIC for piezoelectric Micromachined Ultrasonic Transducers (pMUT). Dr. Yoo is an IEEE Solid-State Circuits Society (SSCS) Distinguished Lecturer (2024-2025 and 2017-2018). He also served an IEEE Circuits and Systems Society (CASS) Distinguished Lecturer (2019-2021). He is the recipient or a co-recipient of several awards, including IEEE International Solid-State Circuits Conference (ISSCC) 2020 and 2022 Demonstration Session Award (Certificate of Recognition), IEEE International Symposium on Circuits and Systems (ISCAS) 2015 Best Paper Award (BioCAS Track), ISCAS 2015 Runner-Up Best Student Paper Award and the IEEE Asian Solid-State Circuits Conference (A-SSCC) Outstanding Design Award (2005, 2021, 2024). He was the founding vice-chair of the IEEE SSCS United Arab Emirates (UAE) Chapter and is the chair of the IEEE SSCS Singapore Chapter. Currently, he serves as an Executive Committee as well as a Technical Program Committee Member of the IEEE ISSCC, ISSCC Student Research Preview (chair), IEEE Asian Solid-State Circuits Conference (A-SSCC, Emerging Technologies, and Applications Subcommittee Chair), and Steering Committee Member of IEEE Transactions on Biomedical Circuits and Systems (TBioCAS). He was an Associate Editor of IEEE Transactions on Biomedical Circuits and Systems (TBioCAS) and IEEE Open Journal of Solid-State Circuits Society (OJ-SSCS).

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