IEEE SSCS Lehigh/Princeton/Columbia Chapters Present
Distinguished Lecture Colloquia, Nov/Dec 2017

Please register at **https://events.vtools.ieee.org/m/48416**

Social Hour: 6:00 pm Packard Lab Room 324

Speaker: Prof. Jerald Yoo
National University of Singapore, Singapore

Talk 1 Title: **Body Area Network - Connecting things together around the body**

Date: Wednesday, November 29, 2017
Time: 6:45 p.m.
Location: Lehigh University
Packard Lab Room 416
Bethlehem, PA 18015

Abstract: Chronic diseases account for over 1/3 of deaths around the world. To mitigate the impact of such diseases, healthcare paradigm is now shifting from reactive illness management towards proactive and preemptive health management; the goal here is to maintain a healthy life in the first place or to prevent illness from getting any worse by continuously monitoring health during normal daily life. Body Area Network (BAN) is an attractive means for continuous and pervasive health monitoring, yet its unique and harsh environment gives circuit designers many challenges. As human body absorbs the majority of RF energy around GHz band, existing RF radio may not be an ideal for communications between and on-body sensors. In order solve the issues, this talk covers two types of BAN: body coupled-based and wired/fabric-based. Body-coupled based BAN utilizes human body itself as a communication medium, where the lecture will begin with channel characteristics, followed by design considerations and transceiver implementation examples. For the wired/fabric based BAN, we will cover several flexible platforms that enable BAN, and discuss what and how circuit designers should consider such non-conventional environments. Low energy circuit techniques to overcome their limitations will also be discussed. We will then will review their various system aspects.

Bio: Jerald Yoo (S'05-M'10-SM'15) 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. Since 2017, he has been with the Department of Electrical and Computer Engineering, National University of Singapore, Singapore, where he is currently an Associate Professor. From 2010 to 2016, he was with the Department of Electrical Engineering and Computer Science, Masdar Institute, Abu Dhabi, United Arab Emirates, where he was an Associate Professor. He has developed low-energy body-area-network (BAN) transceivers and wearable body sensor network using the planar-fashionable circuit board for continuous health monitoring system. He has authored book chapters in Biomedical CMOS ICs (Springer, 2010) and in Enabling the Internet of Things—From Circuits to Networks (Springer, 2017). His current research interests include low-energy circuit technology for wearable bio signal sensors, flexible circuit board platform, BAN transceivers, ASIC for piezoelectric Micromachined Ultrasonic Transducers (pMUT) and System-on-Chip (SoC) design to system realization for wearable healthcare applications. Dr. Yoo is the recipient or a co-recipient of several awards: the IEEE International Circuits and Systems (ISCAS) 2015 Best Paper Award (BioCAS Track), ISCAS 2015 Runner-Up Best Student Paper Award, the Masdar Institute Best Research Award in 2015 and the IEEE Asian Solid-State Circuits Conference (A-SSCC) Outstanding Design Awards (2005). He was the Vice Chair of IEEE Solid-State Circuits Society (SSCS) United Arab Emirates (UAE) Chapter. Currently, he serves as a Technical Program Committee Member of the IEEE A-SSCC, IEEE Custom Integrated Circuits Conference (CICC), and the IEEE International Solid-State Circuits Conference (ISSCC) Student Research Preview (SRP). He is also an Analog Signal Processing Technical Committee Member of IEEE Circuits and Systems Society.

Talk 2 Title: **On-Chip Epilepsy Detection: Where Machine Learning Meets Wearable, Patient-Specific Seizure Monitoring**

Date: Wednesday, November 29, 2017
Time: 8:00 p.m.
Location: Lehigh University
Packard Lab Room 416
Bethlehem, PA 18015

Abstract: Epilepsy is a severe and chronic neurological disorder that affects over 65 million people worldwide. Yet current seizure/epilepsy detection and treatment largely relies on a physician interviewing the subject, which is not effective in infant/children group. Moreover, patient-to-patient and age-to-age variation on seizure pattern makes such detection particularly challenging. To expand the beneficiary group to even infants, and also to effectively adapt to each patient, a wearable form-factor, patient-specific system with machine learning is of crucial. However, the wearable environment is challenging for circuit designers due to its unstable skin-electrode interface to begin with. Wet and dry electrodes have significantly different electrical characteristic that needs to be addressed. Also, in such environment, the trade-off between available resource and performance among the components both in analog front-end and in digital back-end is required.

This lecture will cover the design strategies of patient-specific epilepsy detection System-on-Chip. We will first explore the difficulties, limitations and potential pitfalls in wearable interface circuit design, and strategies to overcome such issues. Starting from a 1 op-amp instrumentation amplifier (IA), we will cover various IA circuit topologies and their key metrics to deal with offset compensation. Several state-of-the-art instrumentation amplifiers that emphasize on different parameters will also be discussed. Moving on, we will cover the feature extraction and the patient-specific classification using Machine Learning technique. Finally, an on-chip epilepsy detection and recording sensor SoC will be presented, which integrates all the components covered during the lecture. The lecture will conclude with interesting aspects and opportunities that lie ahead.