USC Viterbi School of Engineering
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Seminar

Wireless Hybrid Electrical-Acoustic Systems for Body-Machine Interface

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Thursday, March 17, 2022
EEB 248 @ 2pm

Zoom link: https://usc.zoom.us/j/98006617360?pwd=VTBQOU9GWElHRkdjM3I4MFFEeDBkdz09
Meeting ID: 980 0661 7360, Passcode: 489406

Abstract: We have already witnessed significant efforts towards the research and development of neurotechnologies to radically enhance our understanding of the extremely complex central and peripheral nervous systems (CNS and PNS) by modulating and imaging their activities. These technologies can eventually be utilized in establishing body-machine interfaces (BMIs) with the CNS and PNS to offer effective, minimally invasive, and long-term solutions for neurological disorders and chronic disabilities such as spinal cord and brain injuries, stroke, Parkinson's disease, epilepsy, rheumatoid arthritis, and diabetes, to name a few. Despite all the developments over the past decade, closed-loop BMIs with minimally invasive high-spatiotemporal-resolution recording and stimulation capabilities from the large-scale distributed CNS/PNS circuits is still one of the grand challenges of the neuroscience research in the 21st century. In this talk, I will present our recent efforts (and future work) towards the development of advanced minimally invasive BMIs for modulating and sensing neural and electrophysiological activities with high spatiotemporal resolution at large scale. These BMIs are enabled by innovative integrated circuits, ultrasound, and wireless power/data (with different modalities such as ultrasound and magnetoelectric) technologies. I will particularly present two projects that leverage ultrasound beam focusing and steering with electronic beamforming to enable wireless implantable technologies for high-resolution, large-scale brain neuromodulation and gastric electrical-wave mapping.

Biography: Dr. Kiani received his Ph.D. degree in Electrical and Computer Engineering from the Georgia Institute of Technology in 2014. He joined the faculty of the School of Electrical Engineering and Computer Science at the Pennsylvania State University in August 2014 where he is currently an Associate Professor. His research interests are in the multidisciplinary areas of analog, mixed-signal, and power-management integrated circuits; ultrasound; and wireless power/data transfer and energy harvesting for wireless implantable medical devices and neural interfaces. He was a recipient of the 2020 NSF CAREER Award. He is currently an Associate Editor of the IEEE Transactions on Biomedical Circuits and Systems and IEEE Transactions on Biomedical Engineering. He also serves as a Technical Program Committee member of the IEEE International Solid-State Circuits Conference (ISSCC) in the IMMD subcommittee.