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SEMINAR SERIES

Wednesday, March 6th, 2024
Seminar Presentation: 11:00am – 12:00pm
SME Room 248

"Emerging Smart NanoBioElectronics for Personalized Health"

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Abstract: Despite significant advancements in engineering, nanotechnology, medicine, biology, and artificial intelligence computing, the integration gap among these disciplines has significantly hampered the efficiency and evolution of medical practices, including patient monitoring, diagnosis, and treatment methods. Addressing these critical bottlenecks is essential for ushering in the era of precision medicine. Our interdisciplinary research endeavors to bridge this gap through the development of innovative, state-of-the-art, cost-effective, scalable, smart, easy-to-use, and accurate nanotechnology-based Internet of Medical Things (IoMT) devices. These next-generation devices aim to transform the translation of biomedical research into advanced prevention, diagnostics, and treatment strategies in precision medicine.

Our approach involves developing a new class of smart nano/microbioelectronic devices that are wearable and portable, designed to acquire highly specific information about the body's dynamic health status. These devices are designed to be capable of comprehensively and simultaneously assessing time-sequential physiological and molecular profiles through physical sensors for clinically relevant physiological biosignals and electrochemical sensors for detecting a spectrum of clinically relevant biomarkers, including metabolites, electrolytes, nutrients, hormones, and pharmaceuticals, thereby enabling precise and timely feedback. Our current research focuses on two main directions: Firstly, we are developing smart, soft, non-invasive, multi-modal, and flexible nano/microbioelectronic wearable devices. By incorporating functional nanomaterials through emerging manufacturing technologies (e.g., 3D-nanomaterials printing), and supported by intelligent computing techniques and smart, wireless, power-efficient electronic systems, these devices facilitate the collection of properly labeled, time-sequential health data. This data will be parsed using big-data computing techniques and in-sensory data analysis methods, providing interactive, real-time feedback. This enables the capture of personalized health baselines and facilitates reliable predictions of health abnormalities. Secondly, we are pioneering the development of 3D-in-vivo-mimicking organs and Organ-on-a-Chip devices, integrating them with soft bioelectronics. This approach aims to enable the interfacing of electronics with organ/tissue models, overcoming the longstanding barriers between inorganic electronics and organic biological systems. By embedding soft electronics into these 3D-in-vivo-mimicking models, we aim not only to enhance our understanding of disease mechanisms and drug responses but also to achieve accurate in-vitro disease modeling and therapeutic efficacy assessment through the seamless integration of electronics onto, into, and within these 3D-in-vivo-mimicking-organ models. This presentation will showcase how these concerted efforts aim to realize these new classes of bioelectronic devices and technologies that are pivotal in enabling the collection of clinically relevant, accurately labeled, and precise large-scale biomarker data from both humans and human-mimicking-3D-organ models, marking a significant stride toward the advent ofprecision medicine and improving patient care and treatment outcomes.

Biosketch: Dr. Esfandyar-Pour obtained both his M.Sc. and Ph.D. in Electrical Engineering from Stanford University, subsequently expanding his experAse through a postdoctoral scholarship and a role as an engineering research scienAst at Stanford Medical School. He is currently an Assistant Professor within the departments of Electrical Engineering & Computer Sciences, Biomedical Engineering, Materials Science & Engineering, and Mechanical & Aerospace Engineering at University of California, Irvine. His interdisciplinary research group's work in Smart NanoBioElectronics seamlessly bridges fundamental research with pracAcal applicaAons in precision medicine. They focus on innovaAvely addressing crucial boMlenecks to enable precision medicine, with the threefold goal of disease prevenAon, early diagnosis, and effecAve treatments. His contribuAons have been recognized with several awards, and honors including the DARPA Young Faculty InvesAgator Award in 2023, the Early Career InvesAgator Award from the InternaAonal Society for BiofabricaAon, the ITSA Award, and recogniAon as one of the 25 Irvine Innovators Making an Impact in 2023, among other accolades. Dr. Esfandyarpour's research has aMracted widespread aMenAon from various media outlets, including New ScienAst, Nature News, Science Daily, BBC News, NanoMagazine, Azosensor News, Pioneering Minds, HealthTech Insider, Europa Press, and many more.