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Ultra-Low Power Electronics for Smart Healthcare Applications

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Energy-efficient operation is crucial for smart healthcare and Internet of Things (IoT) applications. As these technologies become increasingly pervasive, power consumption remains a critical bottleneck, particularly in battery-powered and energy-harvesting systems. Among various circuit blocks, communication circuitry is often the most power-hungry due to the inherent challenges of the wireless medium, including noise, interference, and free-space path loss.

Addressing these challenges requires a holistic approach. While circuit design plays a fundamental role, achieving orders-of-magnitude improvements demands synergistic innovations in system architectures, signaling techniques, and algorithmic optimizations. This talk introduces a range of strategies aimed at minimizing the power consumption of wireless sensing. Key topics include the development of ultra-low-power wake-up receivers that enable duty-cycled operation, the integration of novel semiconductor devices for improved efficiency, and the exploration of alternative communication mediums that offer new trade-offs in power, range, and reliability.

Additionally, hybrid energy-harvesting techniques—such as RF energy scavenging, ultrasound, and body-channel wireless power transfer—show promise in enabling self-powered wireless nodes. Finally, we will examine other relevant research efforts in ultra-low-power and high-performance communication. As the demand for energy-efficient connectivity continues to grow, interdisciplinary collaboration across circuit design, device technology, and intelligent signal processing will be essential in shaping the next generation of sustainable IoT and healthcare systems.

Prof. Xiongchuan Huang (Senior Member, IEEE) received a B.S. degree in microelectronics from Fudan University, Shanghai, China, and M.S. and Ph.D. degrees (both with Cum Laude honors) from Delft University of Technology, The Netherlands.

From 2008 to 2014, he was a Senior Researcher at IMEC, Eindhoven, The Netherlands, where he worked on advanced integrated circuit design. From 2014 to 2021, he was a Principal Engineer at Broadcom Inc., USA, contributing to cutting-edge developments in communication technologies.

He is currently a Full Professor in the School of Information Science and Technology at Fudan University. His research interests include ultra-low-power integrated circuit design for wireless communication, healthcare, and biomedical applications, as well as high-performance clocking and signal chain solutions for high-speed communications. He has authored or co-authored over 30 academic articles and holds more than 10 patents or pending patent applications.