USC Viterbi School of Engineering
Ming Hsieh Department of Electrical Engineering

Integrated Systems Seminar Series

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Blending Electronics with the Physical World: sensing lots of signals from complex processes

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Think about some of the physical systems with which we would like electronics to interact: physiological systems, high-value industrial equipment, critical infrastructure…. These systems are complex, both in terms of the number of signals they present, and in terms of how those signals represent information. In this talk I will describe some of the hardware platforms we are pursuing to handle these complexities. By sensing 'complex processes', I am referring to an ability to make sense of embedded signals for which no tractable analytical models exist. Instead, we look at how sensor data can itself be used as a knowledge base, exploiting the data-acquisition capabilities of sensor networks towards the construction of high-quality *data-driven* models. Machine learning gives us powerful frameworks for data-driven analysis; the question is how to create very-low-power hardware to enable such frameworks within energy-constrained sensor devices. I will describe our work on low-power medical sensors for disease monitoring and harm detection. Sensing 'lots of signals' implies the ability to acquire embedded signals on a much larger scale than current technologies are equipped to handle. *Large-area electronics* is a technology that can enable the creation of large, flexible arrays of diverse transducers for sensing and energy harvesting. To build complete systems, however, substantial embedded computation, instrumentation, and power management capabilities are also required. We investigate scalable methods and architectures for combining large-area electronics with CMOS ICs to exploit the complementary strengths of both technologies towards translatable systems. I will describe our work towards smart infrastructure, using flexible sensing sheets to build complete, self-powered systems for high-resolution structural-health monitoring of bridges.

Naveen Verma received the B.A.Sc. degree in Electrical and Computer Engineering from the University of British Columbia, Vancouver, Canada in 2003 and the M.S. and Ph.D. degrees in Electrical Engineering from Massachusetts Institute of Technology in 2005 and 2009 respectively. Since July 2009 he has been an Assistant Professor of Electrical Engineering at Princeton University. His research focuses on advanced sensing systems, including low-voltage digital logic and SRAMs, low-noise analog instrumentation and data-conversion, large-area sensing arrays based on flexible electronics, and low-energy algorithms for embedded inference, especially for medical applications. Prof. Verma is recipient or co-recipient of the 2006 DAC/ISSCC Student Design Contest Award, 2008 ISSCC Jack Kilby Paper Award, 2012 Princeton Innovation Forum 1st Prize, 2012 Alfred Rheinstein Princeton Junior Faculty Award, 2013 NSF CAREER Award, and 2013 Intel Early Career Honor Award.