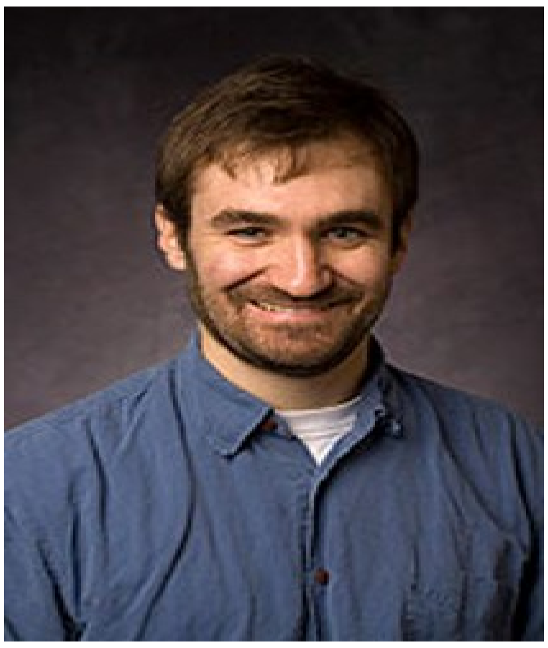
Electrical & Computer ENGINEERING

Department Lecture Series



Analog at the Extremes: Wireless Signals from Watts to Nanowatts

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Thursday, December 6th **4:30 pm 6142 Scott Hall**

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Abstract:
For at least 3 decades techno-polemicists have been saying that analog circuits are "dead", even as the field has exploded both commercially and academically. What is definitely true, however, is that analog circuits have changed, as digital computation and analog-to-digital converters have improved by leaps and bounds, pushing many traditionally analog problems into the digital, and even software domain. A number of problems, however, remain beyond the reach of purely digital solutions. These problems are generally characterized by either extremely constrained power (and so size) budgets, by very high frequency operation, or by very high dynamic range requirements. At the same time, such circuits must be designed with a much more algorithm-aware mindset, as they rarely exist in a computation-free environment. In this talk I will discuss two examples of such circuits. The first is the duplex problem in software defined radios. Here a single transceiver chip has been designed to detect weak RF signals while simultaneously transmitting ~1 trillion times more powerful signals on the same RF port, and to do so at arbitrary (software defined) RF frequencies. Accomplishing this requires a marriage of novel RF circuitry with control and optimization algorithms. The second example operates at the other extreme of speed and power: we have recently developed a tiny (50µm x 250µm) neural implant, able to measure and transduce electrophysiological signals from neurons and transmit them wirelessly. These microscale optoelectronically transduced electrodes (MOTEs) can be entirely powered by light (from a 2-photon imaging setup, for example), at levels safe for the brain, while reporting the entire electrophysiological spectrum (~10Hz-10kHz) at ~$10\mu V_{RMS}$ noise levels through a train of encoded light pulses.

Bio:
Alyosha Molnar received his B.S. in engineering from Swarthmore College in 1997, and M.S. (2003) and Ph.D. (2007) in electrical engineering from the University of California, Berkeley. From 1998 to 2002, he was with the RFIC Group at Conexant Systems, Inc., Newport Beach, CA, where he co-led the development of their first-generation GSM direct conversion receiver, which was also the first direct conversion cellular transceiver successfully sold on the open market. In graduate school, he focused on early sub-milliwatt radio transceivers, and then spent 3.5 years doing electrophysiological experiments on the mammalian retina. In 2007, he became a Faculty Member with the School of Electrical and Computer Engineering at Cornell University. His research interests span RF integrated circuits for flexible ("software defined") wireless systems, novel image sensors and associated image processing, retinal neuroscience, and neural interface systems and circuits. He is a recipient of many teaching and research awards including the NSF CAREER award, DARPA Young Faculty Award, and the ISSCC Lewis Winner award.

(RECEPTION FOLLOWING: SCOTT HALL ATRIUM)