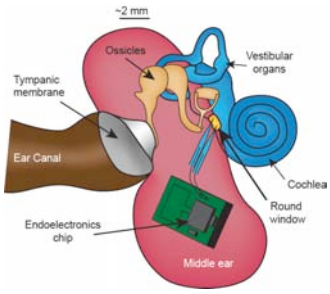
Neuroengineering Seminar

Electrochemical Energy Harvesting from the Inner-Ear



Patrick Mercier

Department of Electrical and Computer Engineering, UCSD
http://efficiency.ucsd.edu

Monday, March 4, 2013
4:00-5:00pm
Fung Auditorium, Powell-Focht Bioengineering Building
University of California San Diego

Current sensing and therapeutic technologies that may be useful for implantable medical applications are typically not deployable in practice due to high energy consumption and anatomically-limited size constraints. Such devices often quickly deplete batteries, thereby necessitating invasive surgical re-implantation procedures, or requiring the use of low-cosmesis transcutaneous wireless power sources that depend on patient compliance for proper operation. In place of artificial power sources, this research explores extracting a very small fraction of the tremendous amount of energy inherently generated and consumed by the human body to power medical electronic devices. Specifically, the endocochlear potential – an electrochemical gradient found within the inner-ear of mammals – is utilized to autonomously power a wireless sensing device. Since the extractable amount of energy is very limited, new sensing, wireless communication, and energy management circuits are presented that leverage extreme duty-cycling and standby energy efficiency techniques to achieve enabling power consumptions that are at least an order of magnitude lower than previous work. Measurement results demonstrating a fully-functional initial prototype will be presented. The transformative biological application opportunities and important technology implications resulting from this work will also be discussed.

Biography: Patrick Mercier joined the Electrical and Computer Engineering department at UC San Diego as an Assistant Professor in 2012. He received his Ph.D. degree from the Massachusetts Institute of Technology (MIT) in 2012, with a doctoral thesis on the topic of communication and energy delivery architectures for personal medical devices. Prior to that, he received his S.M. degree from MIT in 2008, and his B.Sc. degree from the University of Alberta, Canada, in 2006. Prof. Mercier received the International Solid-State Circuits Conference (ISSCC) Jack Kilby Award for Outstanding Student Paper at ISSCC 2010, an Intel Ph.D. fellowship in 2009, Natural Sciences and Engineering Council of Canada (NSERC) Postgraduate Scholarships in 2007 and 2009, and an NSERC Julie Payette fellowship in 2006. His research interests include the design of energy-efficient digital systems, RF circuits, power converters, and sensor interfaces for biomedical and implantable applications.

Organized by:
Institute for Neural Computation: http://inc.ucsd.edu
Institute of Engineering in Medicine: http://iem.ucsd.edu

Sponsored by:
Qualcomm: http://www.qualcomm.com
Brain Corporation: http://www.braincorporation.com