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Advanced Platform Technology Center

A VA Research Center of Excellence

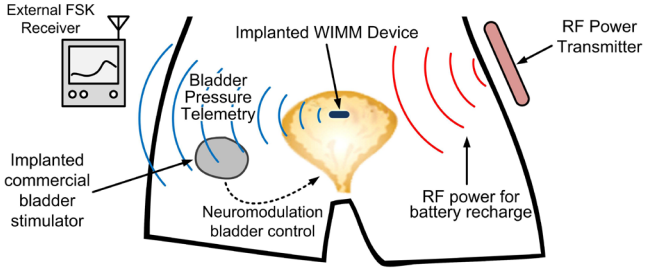
PROJECT OVERVIEW

Wireless Implantable Monitor for Improved Neuromodulation

Bladder dysfunction, including urinary incontinence and overactive bladder, is estimated to affect some 25 million people in the U.S. Our wireless catheter-free device has two applications: 1) to perform short-term diagnostics, and 2) as a chronic implantable device. Both applications rely on the same wireless technology. As we pursued the development of this technology, it became clear that our device could be used to perform another function: providing feedback to an electrical stimulation system.

Existing research suggests that activating a neuroprosthesis to control continence or voiding could be turned on only when needed from a pressure monitor in the bladder in a closed-loop fashion would save power and be much more effective because the nervous system would not habituate to it. This is the primary objective for the current phase of research. Preclinical animal tests are ongoing which should lead to initial trials in humans.

The device is implanted surgically using a minimally-invasive procedure that takes about 30 minutes to complete. The pressure monitor is implanted within the muscular wall of the bladder where it may be safely carried for long periods of time without a risk of stone formation. The implantable device is battery powered, so that it can transmit data continuously to an external radio receiver without encumbering the user. Wireless charging of the implanted device is enabled through intermittent battery charge, which can occur while the user is sleeping.



APT Center Contributions:

- Start up funds
- Wireless sensor system hardware and software design and testing
- Application specific integrated circuit design and fabrication
- 3D-printing of molds for device encapsulation
- Advanced materials for biopackaging for the wireless implant containing transmitter, sensor, battery, and processing capabilities
- Design controls and documentation within a quality system to facilitate future commercialization

Project Funding History:

US Department of Veterans Affairs, Merit Review 1I01RX000443 April 2012 – March 2016

US Department of Veterans Affairs, Merit Review B4934R October 2007 – September 2010

Selected Publications:

"Wireless battery charge management for implantable pressure sensor," Majerus, S., Garverick, S.L., Damaser, M.S, *IEEE Dallas Circuits and Systems Conf.,* Dallas, TX, USA, Oct. 11-13, 2014.

"Power Management Circuits for a 15-μA, Implantable Pressure Sensor," Majerus, S., and Garverick, S., *IEEE Custom Integrated Circuits Conference,* San Jose, CA, September 15–17, 2013.

"Wireless, ultra-low-power implantable sensor for chronic bladder pressure monitoring," Majerus, S., Garverick, S., Suster, M.A., Fletter, P.C., and Damaser, M.S., *ACM Journal on Emerging Technologies in Computing System,* 2012

"Low-Power Wireless Micro-manometer System for Acute and Chronic Bladder Pressure Monitoring." Majerus, S.J.A., Fletter, P.C., Damaser, M.S., Garverick, S.L., *IEEE Transactions on Biomedical Engineering,* 58(3): 763-7, 2011

The **APT Center** is a Department of Veterans Affairs (VA) Rehabilitation R&D Center of Excellence for that creates novel, cross-cutting technologies for the diagnosis, treatment or study of high priority clinical conditions within a structured framework that facilitates regulatory compliance, dissemination within the rehabilitation community and commercialization by outside manufacturers. Center projects have concentrated primarily on developing new materials and microsystems for interfacing with the nervous system, repairing orthopaedic trauma and accelerating wound healing, replacing or restoring natural limb, sensory and organ system function, and both monitoring and promoting neurological, genito-urinary and vascular health. The Center has over 30 investigators, engineering and clinical staff, and support services including regulatory affairs, quality systems, project management and grants administration.

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