Overactive nerves cause many chronic disorders, including heart failure, chronic pain, obesity, and bladder dysfunction. High-frequency electrical stimulation can shut down problematic nerve activity, but only after evoking an initial burst of firing – which can be painful or even dangerous – so its utility is limited. Heat or chill applied to the nerve is another way to treat neural over-activity, but typically only very low (<5°C) or high (>50°C) temperatures are effective, and these extremes can cause permanent nerve damage. In contrast, our new ThermalBlock method uses gentle cooling to shut down problematic nerves, which provides a safe and easy way to manage many types of chronic disease.

Technology Description
A small Peltier electrode is implanted in or around the nerve. Then a wireless-controlled, chargeable, and fully-implantable device can activate the electrode to heat or cool the nerve as desired. As opposed to traditional thermal nerve block technology – which applies a constant extreme heat or cold – our system achieves reversibility by briefly heating the nerve and then cooling it down only to room temperature (15°C). This gentler approach silences the nerve without causing any permanent damage. Testing in anesthetized cats indicates that our thermal block system is effective and safe for bladder control, but the design is sufficiently general that it could easily be applied to other chronic conditions.

Advantages
- Completely eliminates nerve firing
- Easy to implement
- Safe for long-term application
- Reversible

Applications
- Chronic pain
- Heart failure
- Obesity
- Bladder dysfunction after SCI

Stage of Development
- Thermal block tested in vivo
- Implantable device prototype currently in development

IP Status
A non-provisional PCT patent application was filed in December of 2016.

Notable Mentions
- Pitt Center for Medical Innovation pilot funding, 2017 ($65,000)
- Participated in 2017 Pitt Ventures First Gear program to help researchers bring technology to market
Dr. Tai’s research interests include functional neuromuscular stimulation to restore urinary bladder functions after SCI, model analysis of nerve stimulation, and neurophysiology and pharmacology of the lower urinary tract. His research is funded by NIH, DOD, the Christopher and Dana Reeve Foundation, Medtronic Inc., and Ethicon Inc. – a Johnson & Johnson Company. Dr. Tai has published more than 100 peer-reviewed papers and was invited to review grant applications for NIH, DOD, and many private foundations. Dr. Tai is a senior member of IEEE and a member of Society for Neuroscience.

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**Publications**