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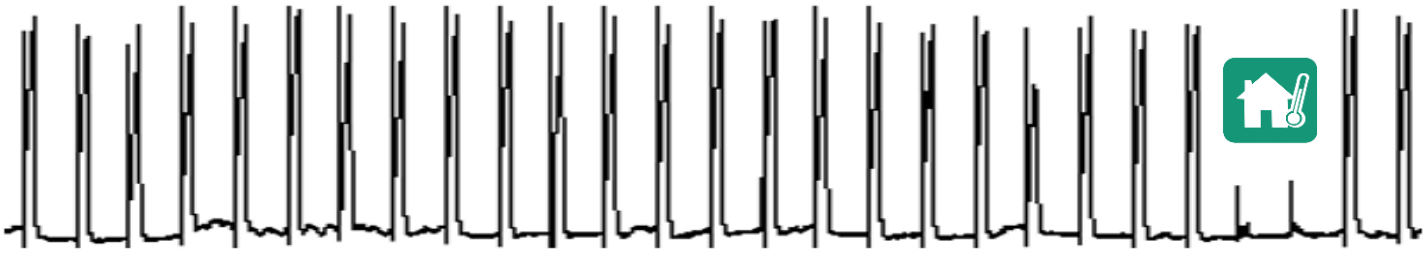

ThermalBlock: Silencing Nerves at Room Temperature ID: 3704

Featured Innovator: Changfeng Tai, PhD

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 wirelessly-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

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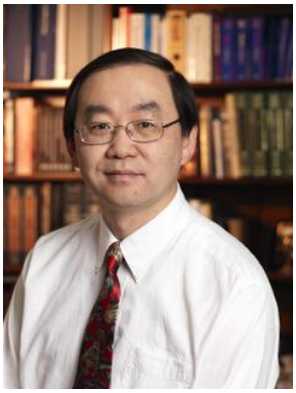

Changfeng Tai, PhD

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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.

Education

PhD in Biomedical Engineering
Xi'an Jiaotong University, China

MS in Biomedical Engineering
Xi'an Jiaotong University, China

BS in Electrical Engineering
Xi'an Jiaotong University, China

Publications

- Zhang Z, Lyon TD, Kadow BT, Shen B, Wang J, Lee A, Kang A, Roppolo JR, de Groat WC, Tai C, "Conduction block of mammalian myelinated nerve by local cooling to 15-30 °C after a brief heating," Journal of Neurophysiology, 115: 1436-1445, 2016.
- Fribance S, Wang J, Roppolo JR, de Groat WC, Tai C, "Axonal model for temperature stimulation," Journal of Computational Neuroscience, 41: 185-192, 2016.
- Yang G, Wang J, Shen B, Roppolo JR, de Groat WC, Tai C, "Pudendal nerve stimulation and block by a wireless controlled implantable stimulator in cats," Neuromodulation, 17: 490-496, 2014.

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