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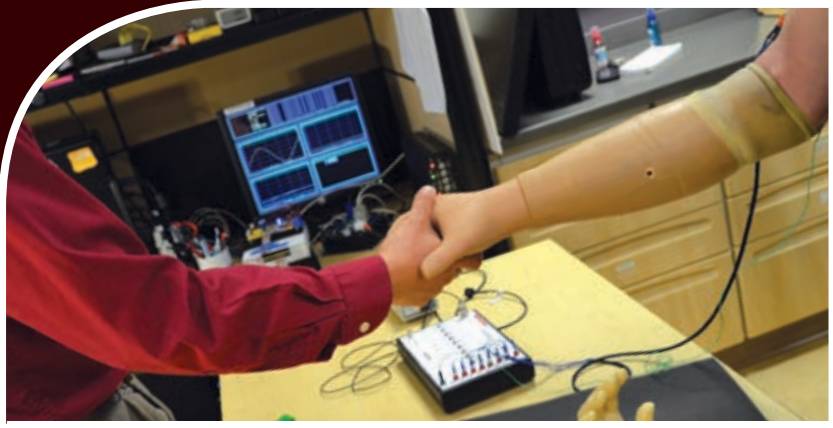
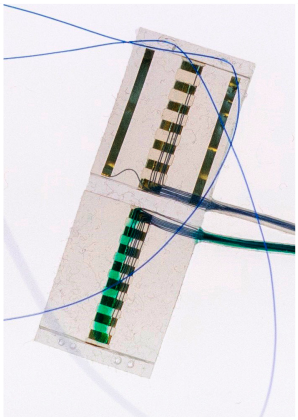
Advanced Platform Technology Center

A VA Research Center





PROJECT OVERVIEW

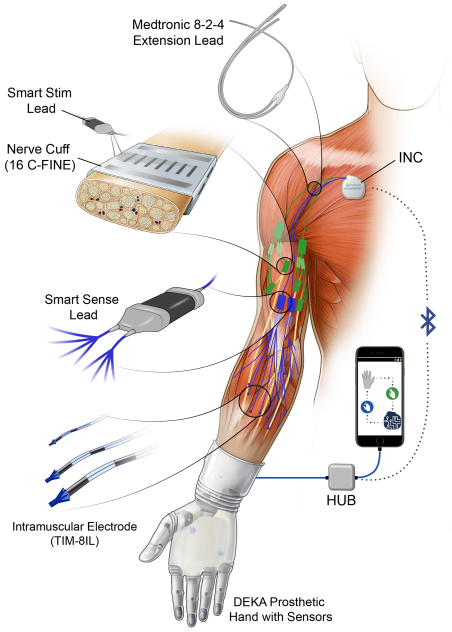
Neural Interfaces for Prosthetic Sensory Feedback

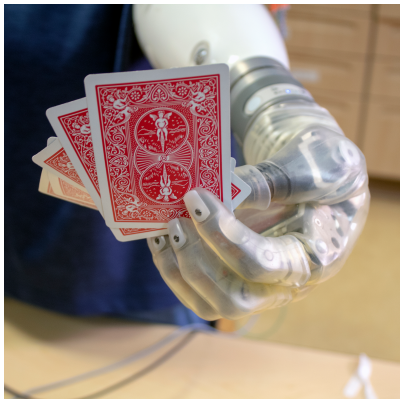
Amputation is one of the most significant non-fatal co-morbidities of combat. Upper extremity amputation is particularly devastating. Upper limb loss also affects a significant percentage of the civilian population. The loss of either one or borh arms results in functional deficits and decreased independence.

We are developing a system that provides sensory feedback for the hand via a direct interface to the residual peripheral nerve. Sensors on a prosthetic hand control stimulation to electrodes around the nerves in the remaining portion of the amputated limb, which cause the nerves to transmit impulses to the brain. These are interpreted by users as tactile perceptions on their missing hands directly related to touch on the prosthesis.

Natural sensation has been achieved in the first study subjects who described the sensation as being equivalent to feeling a pulse with their index fingers.

Sensory feedback increased awareness of the prosthetic hand immediately after turning the system on and improved the ability to grasp, hold and move small objects without looking at them. Furthermore, advanced stimulation techniques are reducing or eliminating the abnormal tingling sensation commonly reported with electrical stimulation. The devices have now been in place for more than a year and may be a viable option for long term restoration of somatosensory function.





APT Center Contributions:

- Thin film, high-density peripheral nerve cuff
- Sensor system hardware and software
- Design controls and documentation within a quality system to facilitate future commercialization
- Regulatory affairs expertise for interactions with US FDA

Project Funding History:

Defense Advanced Research Projects Agency, BAA-14-30, May 2015 - May 2020

US Department of Veterans Affairs, Career Development Award-1 B7932M, July 2012 – June 2014

US Department of Veterans Affairs, Merit Review A6156R, July 2009 – June 2012 National Institutes of Health, R21 NSO58705, June 2007 – May 2011

National Institutes of Health, 2R01 EB00189, September 2003 – June 2011

Selected Publications:

Tan, D. W., Schiefer, M. A., Keith, M. W., Anderson, J. R., Tyler, J., and Tyler, D. J. (2014). A neural interface provides long-term stable natural touch perception. *Sci Transl Med*, 6.

Graczyk, E. L., Schiefer, M. A., Saal, H. P., Delaye, B. P., Bensmaia, S. J., and Tyler, D. J. (2016). The neural basis of perceived intensity in natural and artificial touch. *Sci Transl Med,* 8, p. 1–11.

Schiefer, M. A., Graczyk, E. L., Sidik, S., Tan, D. W., and Tyler, D. J. (2018). Artificial tactile and proprioceptive feedback improves performance and confidence on object identification tasks. *PLoS One*.

Graczyk, E. L., Delhaye, B. P., Schiefer, M. A., Bensmaia, S. J., and Tyler, D. J. (2018). Sensory adaptation to electrical stimulation of the somatosensory nerves. *J Neural Eng,* 15.

Graczyk, E. L., Resnik, L., Schiefer, M. A., Schmitt, M., and Tyler, D. J. (2018). Home use of a neural-connected sensory prosthesis provides the functional and psychosocial experience of having a hand again. *Sci Rep,* 8, 9866.

Graczyk, E. L., Gill, A., Tyler, D. J., and Resnik, L. J. (2019). The benefits of sensation on the experience of a hand: a qualitative case series. *PLoS One,* 14, 1–29.

The **APT CENTER** is a Department of Veterans Affairs Rehabilitation R&D Center 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 focus on the following: prosthetics and orthotics, health maintenance, neural interface and enabling technologies. 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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