PROJECT OVERVIEW

Seated Balance and Trunk Control

Spinal cord injury can result in paralysis of the core trunk and hip musculature that compromises the ability to stabilize the torso while reaching, resist disturbances to sitting balance, and efficiently propel a manual wheelchair, thereby limiting the ability to work and engage in social or leisure activities. We have shown that constant stimulation of the otherwise paralyzed trunk and hip extensor muscles can positively alter seated posture, extend bimanual reach, restore erect sitting, and improve wheelchair propulsion mechanics at slow speeds and on level surfaces. However, the benefits of low levels of continuous stimulation disappear during dynamic movements that either require more stiffness of the core, or modulation of stimulus timing and intensity.

Current development goals for this project include designing new ways to let users set their seated posture to automatically maintain balance, and synchronize stimulation to the trunk and hip muscles with the manual wheelchair propulsion cycle via the voluntary activity of the intact shoulder muscles.

Erect anterior (left), posterior (center) and lateral (right) views of the musculoskeletal model of the torso showing anatomically derived representations of major muscles (red) controlling the trunk and pelvis and physiologically appropriate wrapping surfaces (blue).

APT Center Contributions:

- Wireless sensor system hardware and software
- Control system modeling, design and biomechanical analysis
- Design controls and documentation within a quality system to facilitate future commercialization
- Regulatory affairs expertise for interactions with US FDA

Left is reaching without trunk and hip stimulation; right is reaching with stimulation.
Project Funding History:
US Department of Veterans Affairs, Merit Review 1I01RX001204, July 2013 – June 2016

Selected Publications:

The APT CENTER is a Department of Veterans Affairs Rehabilitation R&D Center of Excellence 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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