University of Utah
UNDERGRADUATE RESEARCH JOURNAL

IMPROVEMENT AND FUNCTIONAL VALIDATION OF A LOW-COST CONTROL SYSTEM FOR ASSISTIVE ROBOTIC DEVICES

Aidan G. Lethaby[1], Jared M. Zollinger[2], Sridharan Radhakrishnan[3], Taylor C. Hansen[2], Alan Kuntz[1], Jacob A. George[4]

[1]School of Computing, [2]Department of Biomedical Engineering, [3]School of Medicine, [4]Division of Physical Medicine and Rehabilitation

The goal of this research is to increase the affordability of portable and intuitive control systems for assistive robotic devices used by patients and researchers. Current control systems are expensive and utilize unintuitive inputs such as foot-mounted inertia measurement units (for prostheses) or oral sip-and-puff devices (for wheelchairs) which place unnecessary physical and mental strain on users The objective of this project is to develop a low-cost intuitive control system based on electromyography (EMG). The low-cost control system consists of a wireless 8-channel EMG acquisition system (TI ADS and Arduino MKR Wifi) and a GPU-equipped mini-computer (NVIDIA Jetson Nano). The entire system is portable, weighing less than 800 grams and featuring over 10 hours of battery life. The high-performance single-board computer enables real-time machine learning to determine an individual's intended movements from EMG. We integrated the low-cost control system with a commercially available prostheses (e.g., DEKA "LUKE" Arm) and then validated the performance of the low-cost control system against a high-end research-grade control system. We found no significant differences between the signal-to-noise ratio of the acquired EMG and no significant differences in functional hand dexterity between individuals using the low-cost and high-end control systems. The low-cost control system can provide researchers and patients an inexpensive and portable option for more intuitive real-time control of robotic devices. Future work will validate the low-cost control system with additional assistive devices for spinal-cord-injury patients, such as powered wheelchairs and adaptive skis.