Abstract 1: Muscular Control of HEXOES, A Multidimensional Hand Exoskeleton

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Approximately 610,000 first-time incidences of stroke occur per year in the US, resulting in serious motor impairment in over 350,000 cases. Assistive hand devices for these individuals are limited, even though hand function in activities of daily living (ADL) is one of the most-desired outcomes from rehabilitation. The Hand Exoskeleton with Embedded Synergies (HEXOES) is proposed in this project which leverages machine learning and kinematic hand synergies, which are common whole-hand motion patterns that form proper hand grasps, to achieve dexterous motion. A series of electromyography (EMG) sensors are placed on the contralateral arm of the user. The EMG signals are interpreted by a trained neural network which determines which combination of three distinct arm movements the user is performing. The detected arm motions are directly converted to kinematic hand synergy commands, actuating the exoskeleton. The movement synergies chosen in this study are thumb flexion and extension, index flexion and extension, and flexion and extension of the remaining three fingers. Future work will use biomechanically-derived kinematic synergies which have been computed previously from hand grasping trails. The ADL grasp study outlined here is currently recruiting individuals with stroke as well as age-matched control subjects. Several grasp performance metrics will be recorded, along with neural network accuracy. These results will quantify HEXOES' performance as a robotic grasp-restoring system.