Development of an Assistive and Rehabilitative Hand Orthosis and Its Complementary Control Systems

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Over 318,000 stroke patients require rehabilitation to regain motor control, but many people around the world cannot afford or do not have access to proper medical care. Furthermore, due to the inability of targeting muscle groups in the rehabilitation process, muscle paralysis can remain after conventional treatment. The purpose of this study was to design an upper limb orthosis that mimics the biomechanical movement and implement controllers in order to enable stroke patients to continue their rehabilitation independently. An orthosis prototype was developed using synthetic joints and tendons to create a variety of movements in order to maximize the degrees of movement in the wrist and thumb. Next, Nylon actuators were created and attached to wire tendons so that actuation of the muscle corresponded to flexion of a finger. Then, a foot based controller and an sEMG interface were developed to control the orthosis. Finally, the parameters of the system were tested in order to refine the both the angular movements of the glove and the response of the controllers. The dynamic orthosis successfully demonstrated the flexion and extension of five fingers in both precision and power grips mimicking the human hand and was controllable through the thermoelectric actuation of the artificial muscles by the foot based controller and myographic signals. This orthosis will allow stroke patients to regain near pre-stroke motor control in the arms but also paves the way for cheap treatment for motor neuron diseases.

Awards Won:

Samvid Education Foundation: Geno Third award