

## **Project Title:** *Rehabilitation of Finger Extension in Chronic Hemiplegia*

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Studies of cortical reorganization following infarcts and preliminary results from studies using robots in therapeutic training suggest that devices which assist in the active production of repetitive movements may prove beneficial in restoring function. We have found that individuals with chronic hemiplegia subsequent to stroke have directionally dependent weakness, such that finger extension is impaired to a greater extent than finger flexion. Thus, we are developing two devices to assist finger extension when needed: a portable, body-powered orthosis and a pneumatically-powered orthosis.



*Body-powered orthosis:* A prototype of this system has been constructed (see left figure). Cables, attached to the fingertips, run through cable housing to terminate eventually in a figure-of-8 shoulder harness. Thus, bicipital abduction and glenohumeral flexion of the shoulder produce finger extension. The cable housing prevents joint hyperextension in addition to controlling the line of pull. A miniature force transducer (Sensotec, Honeywell) in series with the cabling allows measurement of the amount of force required to assist finger extension.

*Pneumatically-powered orthosis:* An air bladder on the palmar surface of the hand is inflated to force the fingers to extend (see right figure). Assistance is only provided when joint angle measurements detect difficulty with extension and the extensor EMG signal exceeds a threshold value. Joint angle, EMG, and pressure signals are recorded.



Both devices will be used in longitudinal trials involving rehabilitative training of grasping virtual objects. Subjects will participate in 3 training sessions per week for 8 weeks using one of the orthoses or no assistance. We have obtained the approval of the Institutional Review Board to begin these trials. Working versions of both orthoses have been completed. We will perform preliminary evaluations with stroke subjects prior to initiating the full study.

*Augmented reality system:* As part of the training, we will provide virtual objects for the subjects to practice grasping. A set of roughly 15 different objects can be displayed through the PC Glasstron® head-mounted display (PLM-S700, SONY Electronics, Inc). Monitoring of head position and orientation allows the object to remain stationary with respect to the head. When the hand is properly positioned for grasping, the virtual object moves with the hand.