A NEW ROBOT-ASSISTED TRAINING DEVICE USING EMG SIGNALS FOR UPPER LIMB TREATMENT AFTER STROKE

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Introduction

Only 5% to 20% of patients with stroke demonstrate complete functional recovery of the affected upper limb [Kwakkel, 2003]. To stimulate motor (re)learning and brain plasticity, motor therapy should include active participation of the patient during repetitive, task-specific and motivating training exercises in high dose [Langhorne, 2009][Cooke, 2010]. In this context, robotic devices offer an 'evidence-based practice' training approach that may enhance motor recovery in stroke beyond what is possible with conventional motor therapy. Furthermore, robot aided therapy provides a response to the predicted increase in the number of persons affected by stroke [Carolei, 2002].

Methods

First, kinetic at kinematic data were obtained from five persons with chronic stroke during mobilization therapy of the affected arm. In addition, input from clinical experts is used to get knowledge about power and movement requirements of the actuator. A stepper motor that is supplied with 24V DC power, drives the robot-assisted training device. Electromyographic signals of the biceps and triceps muscles are used to ensure active participation of the user by thresholding these signals before the actuator supports the intended movement. The passive range of motion (ROM) of the elbow joint of the user is set in the program so the robot assisted training device will not exceed the mobilization limits.

Results

The developed robot-assisted training device for upper limb treatment after stroke is called ACTOR and is shown in figure 1. When the device is in flexion mode and the biceps muscle exceeds a pre-set and individualized muscle activation level, the intended elbow flexion is assisted by the device at a constant speed of 10 °/s. The same principle is applied in extension mode that is linked to triceps muscle activity. Because shoulder mobility is different in all persons with stroke, the shoulder position in which training takes place can vary from 0° to 90° anteflexion.

To ensure safety, both software, electrical and mechanical safety features are implemented in the device.

Figure 1: The ACTOR device in use.

Discussion

Active user participation is ensured and repetitive movements are made when training takes place in the ACTOR device. However, the presented task is not functional and motivating. Furthermore, a device that is more lightweight and wearable offers extra possibilities concerning task specificity and functionality. This is work in progress.

References

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