Proportional Electromyographic Control of a Bionic Arm in Participants with Chronic Hemiparesis, Muscle Spasticity, and Impaired Range of Motion

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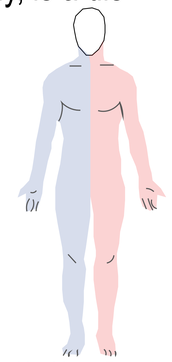
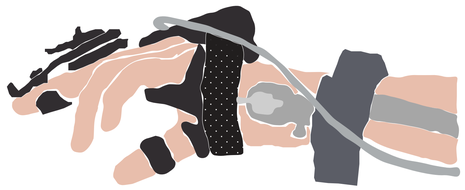
Introduction

• Hemiparesis, paralysis of one side of the body, is a disability that can occur after stroke



• Current electromyography (EMGcontroled assistive devices are limited to binary control (open or close, no inbetween)



Goal: Test feasibility of proportional control from paretic electromygraphy (EMG)

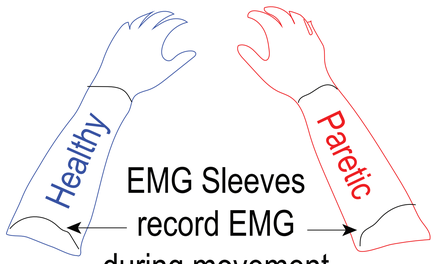
Mimicked Movements Used to Collect EMG Activity

• 4 Degrees of Freedom (DOFs) were recorded and tested

• We compared EMG and kinematics predictions from a modified Kalman Filter

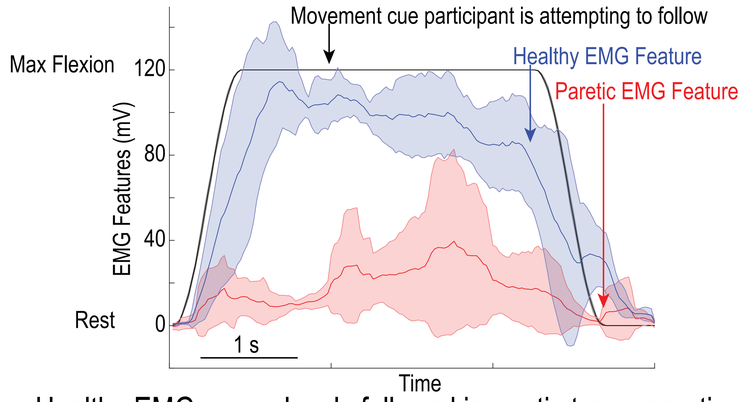
Virtual Hand

• The Movements included: Grasp/Extend, Tripod Grasp/Extend, Wrist Flexion/Extenstion, and Pronation/Supination



EMG Sleeve

Healthy EMG Follows Kinematic Cue Better than Paretic EMG



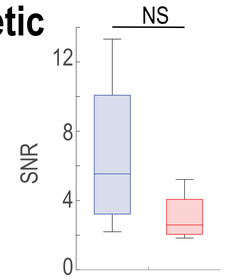
• Healthy EMG more closely follows kinematic trace, paretic traces are more varied, and delayed

Healthy Signal-to-Noise Ratio (SNR) Tend to be Higher than Paretic

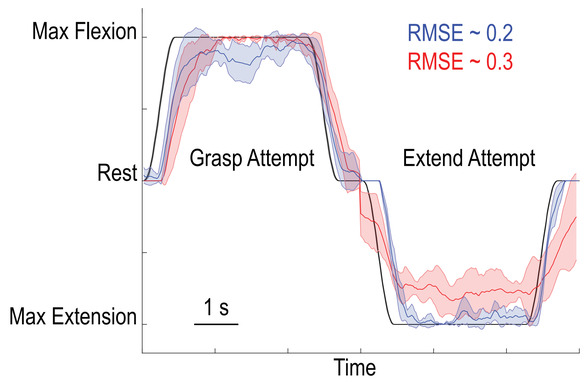
• Higher SNR normally better signal

• Grouped not significant, was significant in individual participants

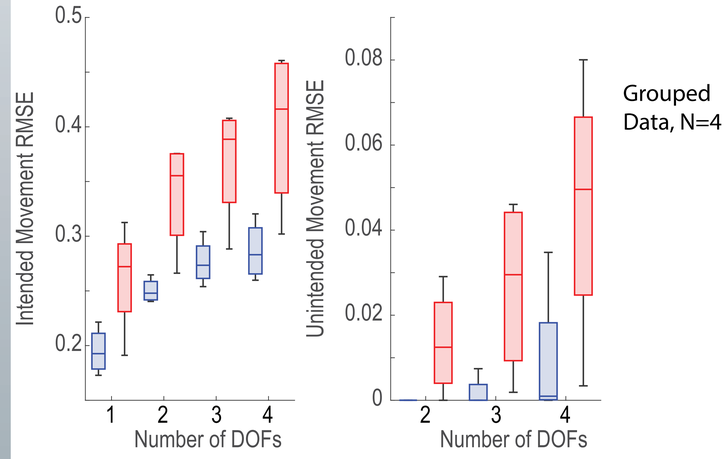
N=4, grouped, p=0.375,



Kalman Filter Predictions from Healthy EMG More Closely Align with Intended Kinematics



Healthy Predictions Tend to be Better than Paretic Predictions



• Intended Movement root mean square error (RMSE) measures accuracy of prediction in intended DOF

• Unintended Movment RMSE measures accuracy of prediction looking at the DOFs that should be at rest

• More analysis needed to provide accurate realtime control of bionic limbs or exoskeletons

Conclusion/Future Work

• Validate analyses with additional participants and task performance

• Explore other EMG-control algorithms

• Use control algorithms in a state-of-the-art exoskeleton with paretic EMG

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