Analyzing Motor and MyoControl using Fitts’ Law

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Introduction

• Dystonia is a movement disorder defined by involuntary muscle contractions causing twisting movements and abnormal postures.[3]

• Children with dystonia have a limited ability to act and play as healthy kids do.

• Humans are able to control external devices using myocontrol, the control of external devices using electrical activity from the muscle. However, myocontrol is typically considered less accurate than force controlled movement.

Goal: To determine the ability of young healthy adults can process information using myocontrol.

Hypothesis

Our hypothesis was that subjects could produce movement generated by myocontrol with a similar speed-accuracy tradeoff that is comparable to motor control.

Methods

Experimental Set-Up

• Subject had to reach the target using electromyography (EMG, the recording of electrical activity of the muscle tissue) from the first dorsal interosseous muscle (FDI) and stay within target for .5 sec

• Each trial was 6 sec

• 15 trials, 20 targets (width and distance varied)

• If the conditions weren’t achieved it was considered a failed trial and not incorporated into analysis

Data and Analysis

• 13 healthy young adults

• Fitts’ law (A model of human movement, this law quantifies the relationship between movement time and target difficulty. Generally in movement, you can be fast with high variability or very accurate but produce slower movement) was used in analysis to quantify the speed-accuracy tradeoff.

• Fitts Law: Movement Time (MT) = a + b * ID
  Index of Difficulty (ID) = log2(2D/W)
  D = target distance
  W = target width
  Index of Performance = (1/b)

Discussion

• Human index of performance using an unsupported index finger is in the range of 3-11 bits/s for motor control. [1, 2]

• We found an index of performance of 3.2 bits/sec for myocontrol using the FDI, which falls within this range.

• Even with some restrictions humans are able to demonstrate control using EMG that is comparable to that of motor control.

• This provides reasonable hope that, with the right equipment, children with dystonia might be able to explore and participate in real-world activities using EMG controlled devices.

References:


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