A COMPARISON OF TRAINING APPROACHES FOR PATTERN RECOGNITION BASED MYOELECTRIC CONTROL

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ABSTRACT

Decades of advancements in the development of myoelectric signal processing techniques have made prosthetic devices an effective means of functional replacement for major upper limb amputees. One of the control approaches that has been widely researched in this field is pattern recognition (PR) based control using electromyography (EMG) signals, which has only recently become commercially available. One challenge to its widespread clinical adoption to this point may be due to the need for training of the PR controller, which requires appropriate collection of example data. Although the inclusion of confounding factors (such as varying limb position) in the training data has been shown to significantly improve the performance of the pattern recognition approach, little work has focused on how to actually elicit the training contractions themselves.

This work examined two existing training techniques that are currently being used in the field (ramp contractions, and velocity guided training), and introduces two new alternative training methods; position guided training and a hybrid position and velocity approach. The comparison of approaches was motivated by a desire to incorporate more dynamic motion into the training process, which may better reflect the actual use case than existing methods and be more intuitive for users. It was hypothesized that more relevant training data would result in improvements in real-time performance and usability in a virtual target acquisition task.

Fourteen able bodied subjects (10 male and 4 female, mean age 24 +/- 2.2 years) completed a Fitts' Law based usability study using controllers trained with each of the training methods. For each method, EMG data representative of five different motions (hand open, hand close, wrist pronation, wrist supination, and no motion) were recorded and used to train the controller, before completing 24 repetitions of the target acquisition task.

Comparison of real-time performance metrics showed no significant difference between the ramp, position and hybrid approaches. Velocity guided training, however, as used in the previously reported prosthesis guided training, obtained significantly better movement efficiency ($p<0.05$). No significant differences were found in the Fitts' law summary metric throughput. These results suggest that, although other training approaches may offer more intuitive training prompts, the currently employed velocity guided training more effectively informs the training of pattern recognition based myoelectric control. Future work will include consideration of cognitive load and motivation on the part of the user, in order to help form a more complete picture of training and usability.