# Comparing EMG- and Goniometer-Driven NMI Control For A Virtual Target Acquisition Task

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## Motivation

Many advanced algorithms have been developed to estimate a user's movement intent from electromyography (EMG) for controlling neural-machine interfaces (NMI), such as myoelectric prostheses [1] and virtual interfaces [2].

Inevitable discrepancies between the estimated and actual movement intent can limit the efficacy of NMI control, especially for the wearer of the prosthesis.

We previously developed a novel EMG-driven NMI controller based on a musculoskeletal model of the hand [3].

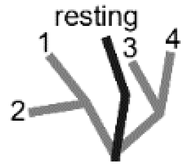
**The objective of our study was to determine the effect of the model's movement estimation discrepancies on subject's performance of a real-time virtual target acquisition task.**

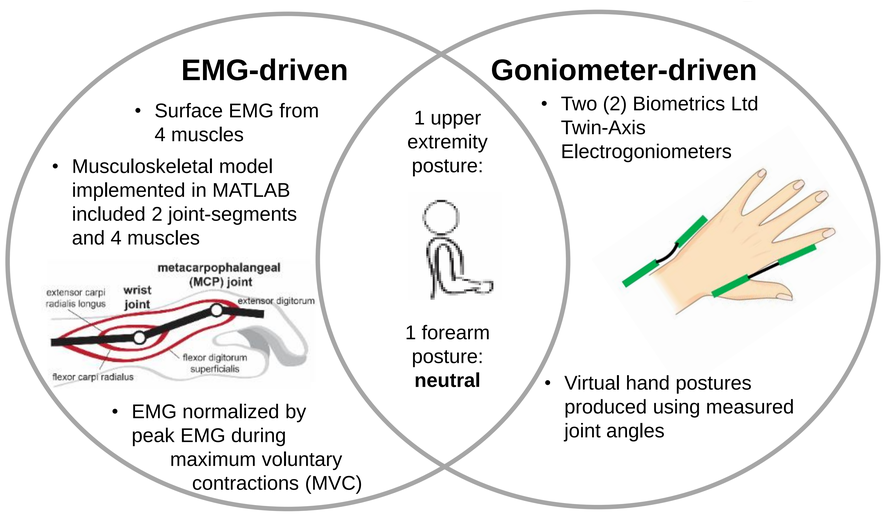
**Hypothesis:** Task performance would be worse with the EMG-driven musculoskeletal model than when the users' hand kinematics were used directly to control the virtual hand's movement.

## Experiment Design

### Real-Time Virtual Task

Four able-bodied subjects attempted to match four target postures (grey lines in figure at right) starting from a base posture (black lines) with a 2-DOF virtual hand, sequentially and in a randomized order.

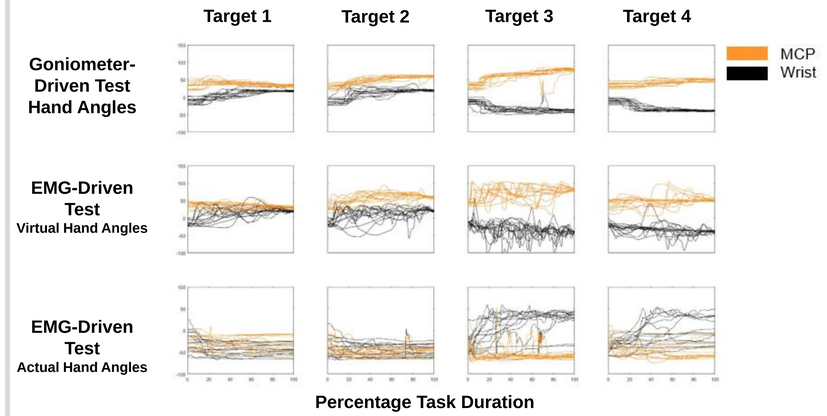


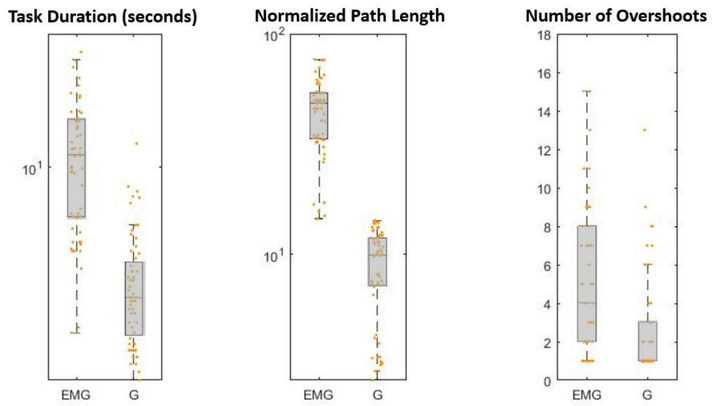

| PERFORMANCE MEASURES | |
|---|---|
| **Task Duration** | Time required to move within target posture for 1 consecutive second |
| **Normalized Path Length** | Trajectory length (in joint space) divided by minimum possible trajectory length |
| **Number of Overshoots** | Number of times virtual hand moved in then out of target posture |

## Results

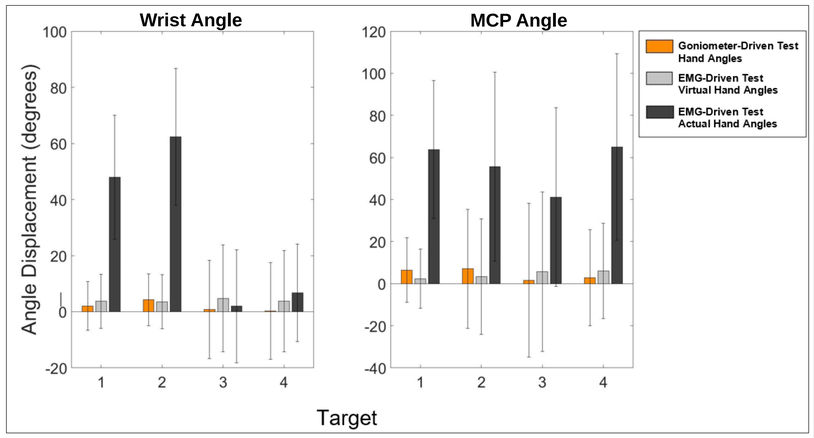
**It was easier for subjects to complete the goniometer-driven test than the EMG-driven test, as indicated by less oscillatory hand movement during the goniometer-driven test.**




**There was a trend of better overall task performance for the goniometer-driven test (G) than for the EMG-driven test (EMG).**




**For the EMG-driven test, there was an average angle discrepancy of 40-60 degrees between the measured and target hand angles at both joints.**




## Conclusion and Future Work

As expected, our results suggest that the accuracy of movement estimates influences real-time task performance for EMG-based NMI control.

Errors could potentially be reduced by improving controller calibration procedures.

This study was limited by the low number of subjects tested and high inter-subject variation.

In the future we will potentially evaluate more muscles, incorporate more degrees of freedom, and evaluate the effects of other error sources (e.g. estimation delays) on task performance.

## Acknowledgments

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## References

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