# A Motion Capture Study to Analyze Finger Joint Coordination during Daily Tasks

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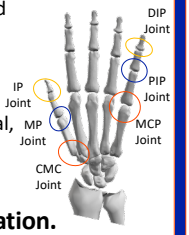
## Introduction

- The hand, a complex structure with 19 finger joints, enables grasp and object manipulation through intricate finger motions [1].
- Today, most studies examine finger motion during highly constrained tasks [2,3], with few studies examining more complex activities [4].
- As a result, how finger joint movements are coordinated during typical, daily tasks is not fully understood.

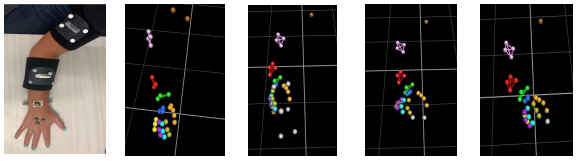



**OBJECTIVE: Examine finger motion during five tasks and propose a quantitative method to evaluate joint coordination.**

## Methods

### Record

*Motion capture data was recorded with a 12-camera Vicon system for this study.*



Data was recorded from 8 healthy subjects (mean age: 23 yrs, height: 172 cm and weight: 70 kg) during 5 tasks in this IRB-approved study.

*Output*
Raw Data from Skin-Marker Motion Capture

### Process

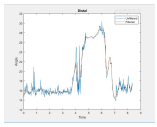
*Data processing was done using tools in VICON, OpenSim and MATLAB*

Fill-in marker gaps

Run transformation code

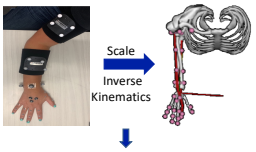
Filter data

Butterworth 4th order, low-pass filter with cutoff frequency of 6Hz



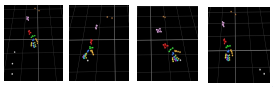
OpenSim

*Buffi et al. [8]*




Normalization of events

4 events were detected as part of tasks cycle – Lift up, Grasp, Release, Rest

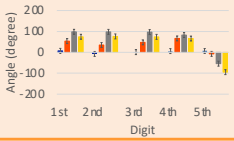


*Output*
- Joint angles vs. normalized activity
- 3,040 joint angles vs. time

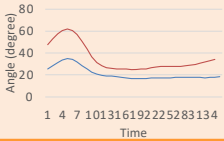
### Analysis

*Data analysis was performed using two approaches to examine joint coordination across joint, finger, task, and subject.*

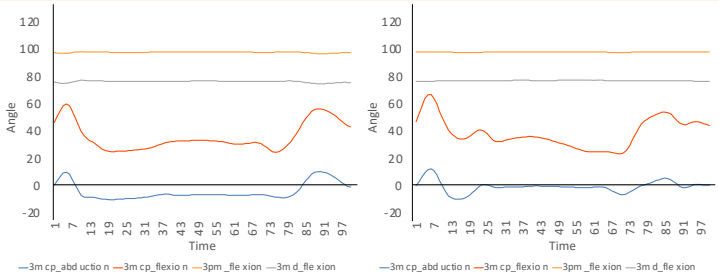
Ratios



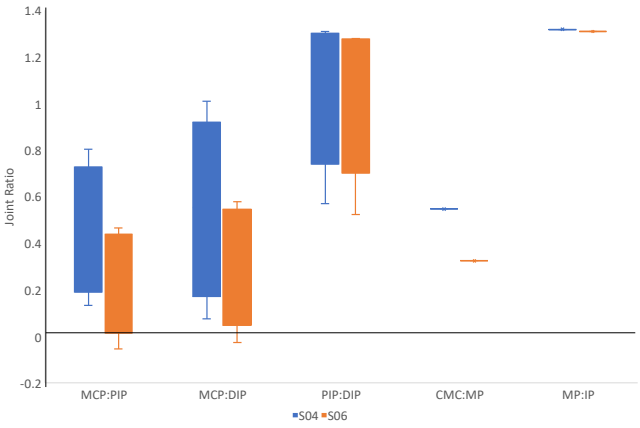

Variability




## Results & Discussion




- The index finger adopts a similar joint coordination strategy for both tasks.
- The majority of the coordination is performed by the metacarpal joint to flex/extend and adduct/abduct.
- Graph displays results for one simple and one complex task for a subject.




- The ratios for the MCP:PIP and MCP:DIP had a consistently larger difference across subjects and digits than that of the PIP:DIP

## Conclusions

- Our work shows that we are able to examine finger joint coordination across subjects, tasks, fingers, and joints.
- These results suggest that most of the movement produced by each of the fingers is performed by the MCP joint.
- Future work could include examination of how age, sex, and hand dominance affect joint coordination.

## References

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