Ultrasound Imaging of Flexor Muscles for Finger Motion Tracking

Visualization and Image Analysis Laboratory

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Background

- In open surgery, quality of the procedure can be evaluated by tracking the motion of surgeons' fingers
- Mounting mechanical encoders or trackers can affect normal use of the hand
- Analyzing video images can be limited by visibility
- The flexor digitorum muscles cause the fingers to flex

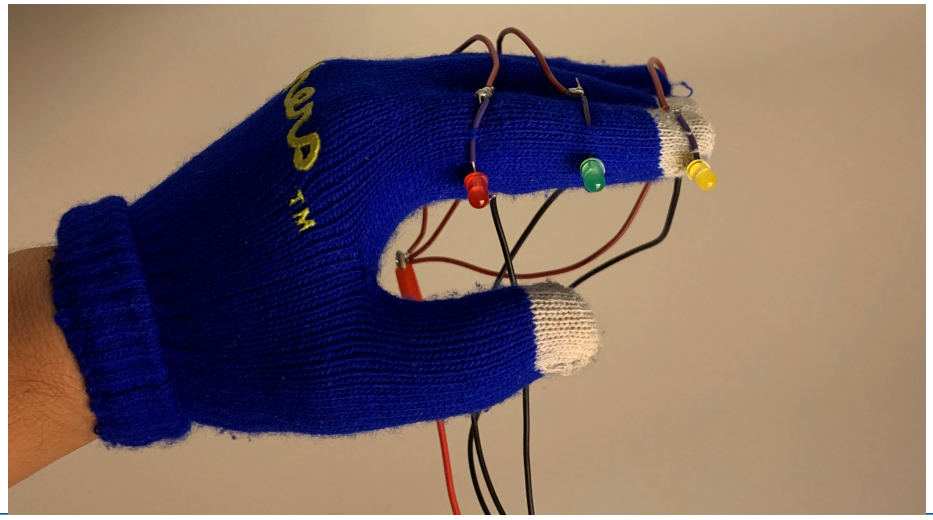
Purpose of Study

- We propose a method of determining the positions of the index finger by using ultrasound to monitor the contraction and relaxation of the flexor digitorum superficialis muscles

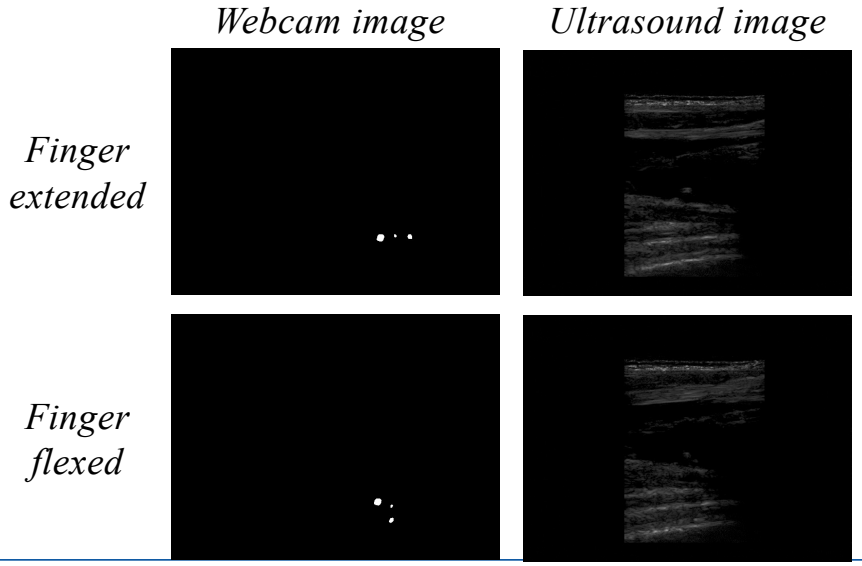
Methods

- **Imaging of the flexor muscles:** Terason t3000 ultrasound system
- **Finger motion tracking:** three LEDs attached to the index finger, tracked with a 720p webcam
- OpenCV was used to capture concurrent video recordings from both the Terason and the webcam
- For each frame, the width of the muscle (in pixels) and the angle of the finger (in radians) was recorded
- Videos were recorded for 89 frames in total

Glove used for finger motion tracking

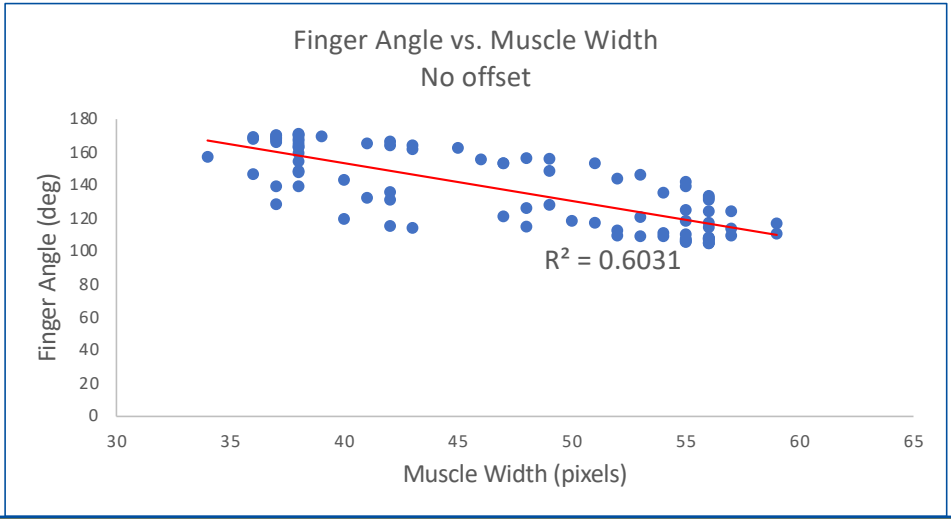


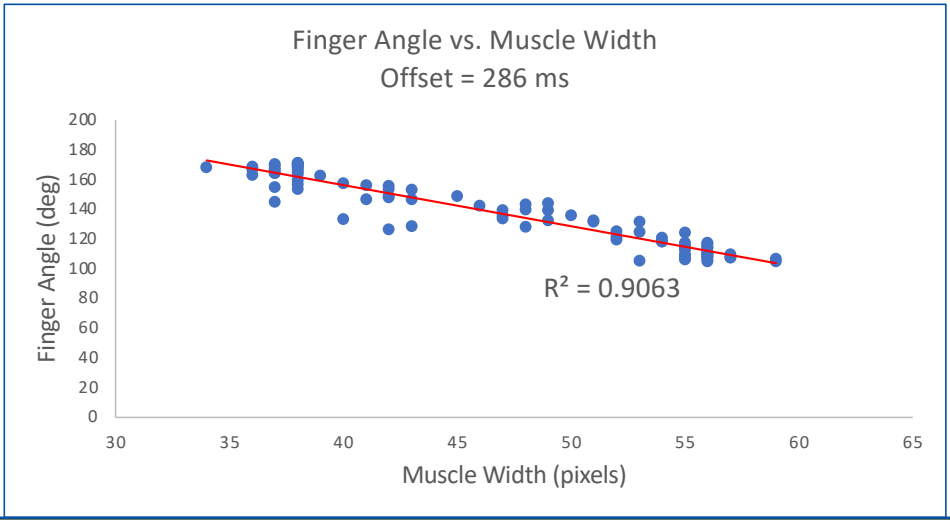
Sample images during finger tracking



Results

- Negative correlation between muscle width and finger angle is observed
- Significant lag between movement of muscle and finger
- Offsetting data by 286 ms results in proportion of variation $R^2 = .91$
- It may be possible to determine the position of a finger using only ultrasound imaging of the muscles in the wrist





Future work

- Identify and prevent causes of lag to improve accuracy of the linear model
- Develop machine learning methods to more accurately predict finger position from ultrasound image sequences