Evaluation of the accuracy of the Leap Motion controller for measurements of grip aperture

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CCS Concepts

•**Human-centered computing** → **Laboratory experiments;** •**Hardware** → *Sensors and actuators;*

The Leap Motion controller allows for a mouse-free alternative to general computing. With 200 frames/second infrared cameras, a 150° field of view and an 8 ft^2 umbrella of interactive space, the Leap Motion has many potential practical applications. The device is advertised as aiming to be placed in new cars, laptops and hospitals, for example, to provide contact-free device control, while reducing the need for attentive button pressing and averting eye focus.

We assessed the accuracy of the Leap Motion when the correct hand position is known. Other studies have also assessed the accuracy of the device, tracking either a reference pen manipulated by a robot arm [1], or the positions of participant's fingers while pointing at a computer screen [2]. We assessed the accuracy with which grip aperture (the separation between the thumb and forefinger) can be measured. This gesture is useful for indicating the size of objects, or the separation between points. Thirteen wooden rods were created in centimetre increments between 1 and 13cm. These were held by participants between their thumb and forefinger tips above the Leap Motion, before removing them, but keeping the hand position stable (Figure 1a). Ten trials were completed before checking the size with the rod and repeating for another 10, giving 20 repeats for each size. The endpoints of the participant's fingers were recorded from the Leap Motion using MATLAB and Matleap [3], and the Euclidean distance between the endpoints was calculated.

A linear regression was performed on the median separation as measured by Leap Motion, against the actual grip aperture. This accounted for between 94.8 and 98.4% of the variance, across participants. Each participant's regression equation was used to calculate a grip aperture estimate from the Leap Motion data on each trial. The mean, median and RMS error, for each grip aperture, were then calculated for each participant (Figure 1b). The mean RMS was greatest

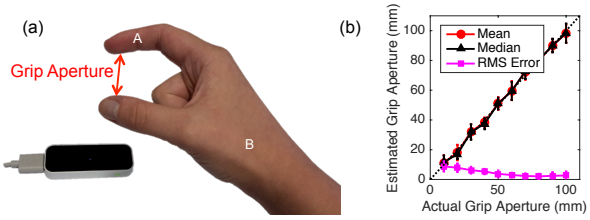

Figure 1: (a) Leap Motion was used to measure the grip aperture. This figure shows (A) the inter-phalangeal joint and (B) the cleft below the trapezoid. (b) The mean, median and RMS error of the estimated grip apertures. Data points plot the mean across 7 participants, error bars show ±1 standard deviation.

for small grip apertures (8.78mm at 10mm) and reduced with increasing grip aperture (2.67mm at 100mm). The mean RMS error was 4.44mm; for grip apertures larger than 50mm, mean RMS errors were always smaller than 4mm.

A bend in the inter-phalangeal joint was necessary for reliable measures. Measurements were taken from the cleft below the trapezoid to the tip of the straightened forefinger and thumb for each participant (Figure 1a). The square root of the sum of these lengths squared was then calculated. Only participants for whom this length was over 19cm could be tracked accurately for grip apertures greater than 10cm.

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1. REFERENCES

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[3] https://github.com/jeffsp/matleap.git

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