

# Video game based kinematic assessment using a Leap Motion Controller

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## Summary

A game-based approach to capture and assess hand kinematics, using a Leap Motion Controller (LMC) as the main peripheral, was developed in [1]. The analysis focused on the performance of able-bodied subjects performing pick and place operations in the virtual environment using a pinch grip. Data was compared inter trial and inter participant as well as against data from available database [2].

## Introduction

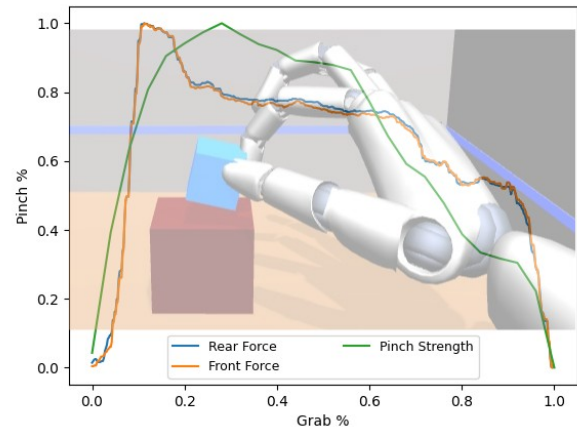
The game was a virtual take on the standard peg-test (NHPT) [3]. Participants performed pick and place operations within the virtual environment defined by the game, running on Unity3D, while positional data was recorded simultaneously. The pinch strength, defined by Leap's API was compared against data generated by a study that analysed force exchange during object grasping using an iBox based setup.

## Methods

Ten participants, age: 22,3 ( $\pm 2$ ), volunteered to take part in the experiment using only their stated dominant hand. Each participant was considered able-bodied in terms of being able to perform a pinch grip. Motion tracking was done using a well calibrated LMC in a portable setup with an estimated total latency of less than 100ms. Participants were shown a play through of the game but not given any rehearsal trials. Each participant then played the game three times whilst data was recorded for each trial and each participant separately. Data was timestamped, giving an overall time score, which also served as a secondary assessment of the participants motor skills.

## Results and Discussion

All participants were able to successfully complete the experiment showing the stability of this game-based setup. The pinch strength parameter, given by the LMC was found to have an inverse correlation with the distance between the index finger and thumb tips. Normalising the tracked Pinch Strength then allows it to be compared against an actual force measurement, (Figure 1). Both data indicates a rapid increasing in the beginning of the grip phase with an overshoot. The adaption phase using the LMC is less quickly or sometimes missing most likely due to absent physical feedback. Participants in general were able to better their time scores from an average of 74.1 seconds ( $\pm 39.69$ ) to 38.6 seconds ( $\pm 11.68$ ). Which suggests an adaptation phase occurred regarding the task.



**Figure 1:** Course of the Pinch Strength compared against Force measurement on the iBox faces (Normalised) blended with a screenshot of the pick and place task in the virtual environment.

## Conclusion

Similar to assessments using the NHPT, participants on average, decreased their overall used time needed to solve the operations along the trials. Compared against data resulting from actual force sensors shows that the pinch strength is not to be taken as an actual measurement of force but rather as an indicator of the current pinch pose. Furthermore, the data suggest that visual feedback given by the game might replace the missing physical feedback to some extent.

## Acknowledgments

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## References

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