Validation of Marker and Markerless Motion Capture Systems

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Research Question

How accurate is Gaitly, a 2D markerless motion capture technology, in comparison to OptiTrack, a 3D marker-based MOCAP system for the use of clinical diagnosis and rehabilitation?

Background Information

- Motion capture (MOCAP) can be used in animation, sports, recreation, the study of biomechanics, medicine, and rehabilitation (Han & Bo, 2015).
- There are two main types of MOCAP systems; marker-based and markerless technologies.
  - Marker-based technologies, like OptiTrack, require the user to wear a marker suit.
  - Markerless technologies, like Gaitly, do not require the user to wear any physical equipment.
- Marker-based MOCAP systems require multiple specialty cameras to determine the 3D position of markers on the object it is tracking.
- Marker-based MOCAP systems can either use passive or active markers.
  - Passive markers reflect light into the cameras but do not produce any light or have any technology themselves.
  - Active markers emit light or signals for the MOCAP system to pick up.
- Markerless systems have programming that locates specific anatomical landmarks on video instead of requiring markers.

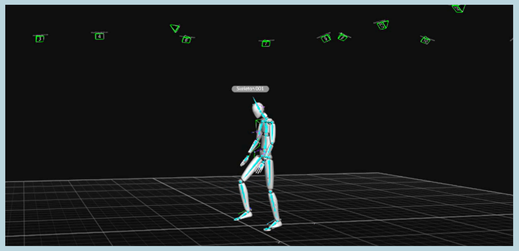

Figure 1: OptiTrack Computer Simulation

Comparison

Marker-based	Markerless

• Highly accurate
• Tried and true
• Expensive
  ◦ Requires lots of specialty equipment
• Needs lots of space and training
• Uses specialty cameras to determine position of reflective markers
	• Usually less accurate
	• Fairly new technology
	  ◦ Limited information and databases
	• Cheaper
	• Requires less space
	• Requires less data
	  ◦ Reduces the collection and processing time
	  ◦ Increases 'data versatility' (Wade et al., 2022).
	• Uses regular cameras with specific programming for pose estimation (Desmarais et al., 2021).

OptiTrack	**Gaitly**
• Uses series of 3D cameras and a computer simulation that track passive markers on a specialty suit. • Known as the "gold standard" • Range of error from 0.2mm to 20 µm (Schroeder et al., 2022).	• Uses two, 2D mobile device cameras. • Requires no additional technology. • Range of error around 20-40mm (Desmarais et al., 2021).

Figure 2: OptiTrack Camera (OptiTrack - Prime 41, n.d.)

Methods

22 different assessments, 4 main categories, 84 tests (including repetitions)

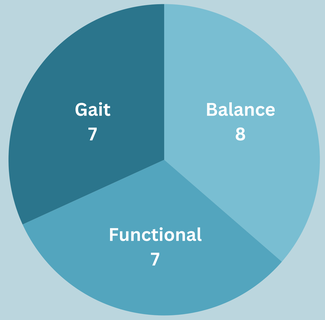

Figure 3: Test Categories

Figure 4: Participant Categories

Study type: Test - Retest

- Acts as a reliability test
  - Meant to assess Gaitly's consistency and reproducibility
- We are subjecting participants to the same test, recorded simultaneously by two systems and comparing the results.
  - OptiTrack acts as the "gold standard" and we want see if Gaitly can produce similar results to the OptiTrack system.

Data Collection

- Simultaneous recording of both Optitrack and on two mobile device cameras (iPad).

Figure 5: OptiTrack Marker Suit

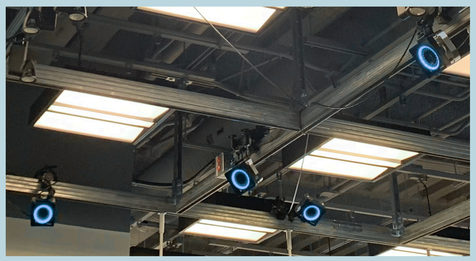

Figure 6: OptiTrack Rig/Camera Setup

Future Analysis

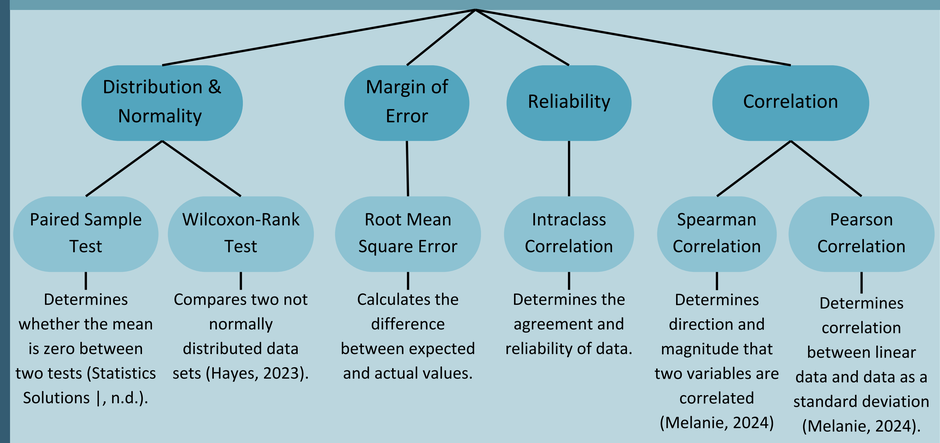

Figure 7: Visual Breakdown of Analysis

Later, the data will be sent as C3D files through Sharepoint to Okaki (the company developing Gaitly) and will be analyzed using SPSS, MatLab, and Motion Monitor.

Conclusion

- Next steps include an ethics review, participant recruitment, experimentation, and data analysis.
- In the future, the data will be analyzed to see if Gaitly could be accurate enough for clinical and at home use.
- If Gaitly is determined to be accurate enough for clinical use, it could help...
  - People track their rehabilitation at home.
  - Rural areas with limited access to healthcare.
  - Shorten wait times to see physical therapists or specialists.
- In the future, bigger databases and more accurate algorithms need to be created to be able to get higher accuracy of videos and to be able to diagnose and monitor more disabilities.

Acknowledgements

Thank you to the Rehabilitative Robotics Lab for having me this summer.
Also, thank you to all the sponsors, WISEST, and the University of Alberta who created this internship as well as Yadhiera Despeines and Gloria Sanouvi-Awoga who worked with me on this project.

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