INTER-SESSION REPEATABILITY OF MARKERLESS MOTION CAPTURE BETWEEN COMFORTABLE AND FAST GAIT SPEEDS

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Summary

Markerless motion capture, an alternative to traditional marker-based motion capture, was evaluated for its repeatability across different gait speeds. Thirty-four adults completed walking trials at both comfortable and maximum walking speeds across two sessions. Statistical Parametric Mapping demonstrated significant kinematic differences between walking speeds, but no significant differences between visits for hip, knee, or ankle angles, demonstrating strong inter-session repeatability. These findings support the use of markerless motion capture for clinical gait analysis.

Introduction

Marker-based motion capture is the gold standard for clinical gait analysis; however, markerless motion capture, which uses artificial intelligence and deep learning algorithms to analyze human motion, has continued to grow in prevalence. Many studies have found strong validity of these systems when compared to marker-based capture [1,3]. Further research is still needed to understand the repeatability of the markerless systems under varying gait conditions. The purpose of this study was to determine the inter-session repeatability of a markerless motion capture system between comfortable and maximum walking speeds.

Methods

Thirty-four healthy adults (Age: 28.2±10.1yrs; Height: 168.3±7.6cm; Mass: 73.5±15.9kg) participated in this study. Participants completed two sessions, one week apart. Participants wore self-selected clothing and performed at least three walking trials at each a self-selected comfortable and maximum walking pace. A markerless motion capture system (60Hz, Miqus Hybrid, Qualisys AB, Goteborg, Sweden) was used to measure kinematics, while six force platforms (1200Hz, BP600900, AMTI, Watertown, MA) were used to assess gait events. Three-dimensional pose estimations were conducted using Theia3D (2022_1_0_2309 patch 14, Theia Markerless Inc., Kingston, ON). Gait biomechanics were compared between walking conditions for the first visit (V1) and between visits for each walking condition. Left leg hip, knee, and ankle angles across the gait cycle were compared with a two-tailed paired sample t-test (<0.05) using statistical parametric mapping (SPM) (Sift, HAS Motion, Kingston, Ontario). All SPM analyses were conducted from left heel strike to the next left heel strike for each full gait cycle.

Results and Discussion

SPM was used to assess the percentage of significant differences in the time-series waveforms of the hip, knee, and ankle joints for the sagittal (Hip: 82%, t = 3.15; Knee: 81%, t = 3.22; Ankle: 88%, t = 3.24), frontal (Hip: 44%, t = 3.22; Knee: 1%, t = 3.31; Ankle: 50%, t = 3.31) and transverse (Hip: 6%, t = 3.17; Knee: 2%, t = 3.18; Ankle: 43%, t = 3.33) planes between the two-speed conditions during V1. The greatest percentage of significant differences were found in the sagittal plane for each joint. There were no significant differences found between visits for either the comfortable or the maximum walking conditions.

Markerless motion capture was shown to be repeatable between days, regardless of walking speed. As expected, walking kinematics varied with speed [2]. This study further demonstrates that markerless motion capture is sensitive to accurately assessing gait kinematics between gait speeds. These findings support the use of markerless motion capture for clinical gait assessments, regardless of movement speed.

Participants wore self-selected footwear and clothing for each visit. The effects of both should be further studied for their impact on the repeatability of a markerless motion capture system.

Conclusions

Markerless motion capture demonstrates strong inter-session repeatability and effectively detects variations between walking speeds.

References

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