THE FEASIBILITY OF INERTIAL MEASUREMENT UNITS (IMU) IN CAPTURING BASIC UPPER BODY MOTION

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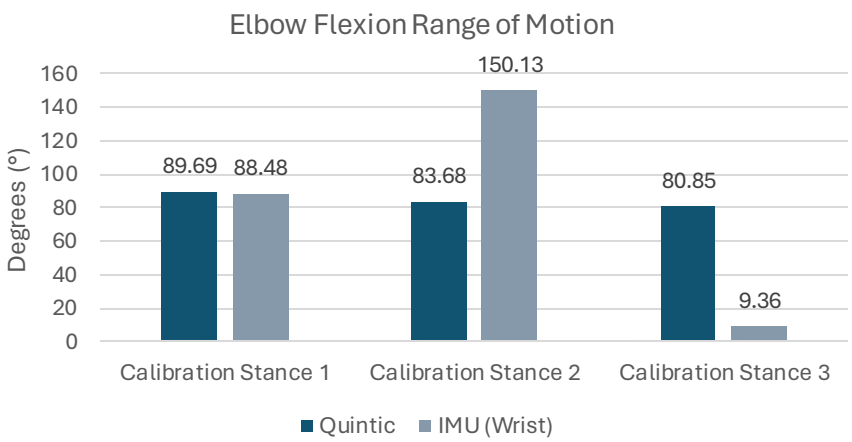
Introduction

- Three- Dimensional (3D) motion capture is accepted to be the gold standard approach to all data collection to produce accurate data. Yet concerns over the ecological validity of 3D systems has come into question [1]. This has brought about the exploration of alternate methods such as Inertial measurement units (IMU's).
- The depth of research on IMU usage in wheelchair data collection is limited, primarily focused on the use of IMU's rather than studies aiming to ensure their reliability and accuracy
- This single-subject pilot study aims to explore the feasibility of using IMU's for capturing basic upper body motions, To assess the potential limitations of IMUs in accurately measuring elbow and shoulder flexion.

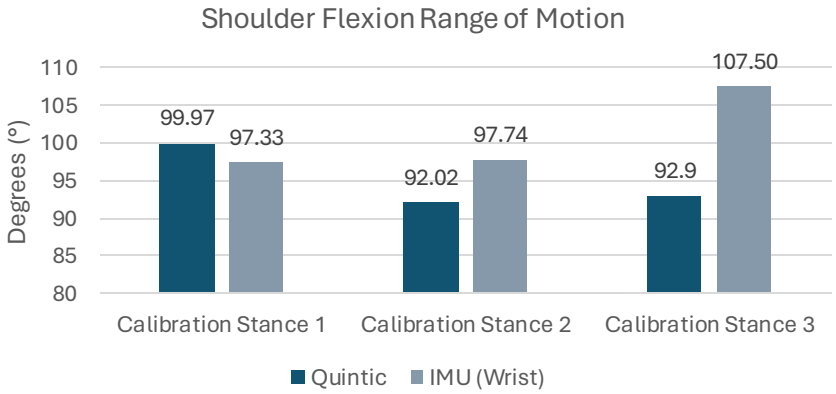
Methods

- Three IMU (Vicon Blue Trident sensor, Vicon, Oxford, UK) placements and 3 calibration stances were investigated for the collection of elbow flexion and shoulder flexion.
- Elbow flexion placement: one at the wrist and one centrally on the forearm.
- Shoulder flexion placement: one IMU situated 1 cm above the elbow joint
- Calibrations phases: Arms in anatomical position thumbs forwards (stance 1), palms outwards (Stance 2), joint of interested at 90 degrees of flexion (Stance 3)
- Trial started in a neutral position and the participant moved through 90 degrees of flexion for the joint being measured and returned to 90°
- Quintic biomechanical software (Quintic Biomechanics v25 Video Analysis Software, Quintic Consultancy, West Midlands, UK) was employed as the validated reference system for data comparison and analysis

Results and Discussion



- The wrist placed IMU determined elbow flexion more accurately than the forearm placed IMU
- Calibration stance one resulted with more accurate segment angles in comparison to Quintic
- Shoulder and elbow flexion at 100.0 and 89.7° respectively compared to 88.5 and 97.3°.
- Maximum values were over predicted for both elbow and shoulder flexion with differences of 27.8° and 6.6° respectively.



- Range of motion for shoulder and elbow flexion were accurately measured in relation to quintic
- Differences in maximum and minimum values are likely due to error in determining the global coordinate system during data processing

Conclusion and references

- The accuracy in range of motion prediction, presents the scope for further research into the use of IMU's in elements such as bilateral differences during wheelchair activities, giving scope for investigation into factors such as ground type effect on basic upper body motion during wheelchair propulsion.

[1] Briley, S. J., Vegter, R. J., Goosey-Tolfrey, V. L., & Mason, B. S. (2022). Alterations in shoulder kinematics are associated with shoulder pain during wheelchair propulsion sprints. *Scandinavian journal of medicine & science in sports*, *32*(8), 1213-1223.