LOW COST MOTION CAPTURE SYSTEM USING SMARTPHONES

Aggie Challenge Project

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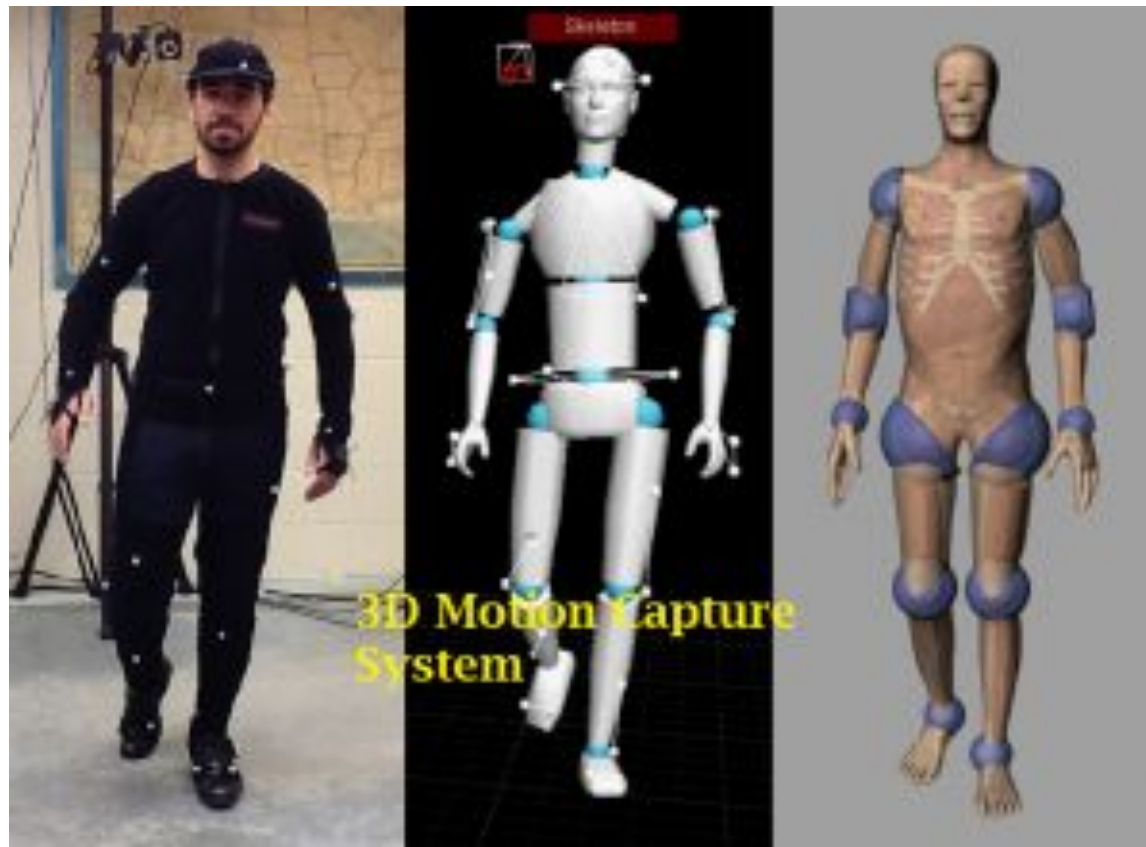*Advisor: Dr. Pilwon Hur*
Mentor: Woolim Hong

What is MoCap?

Acquisition of 3D position data over time

Motion Capture (MoCap) System

3D Motion Capture System

Value of Motion Capture Data

- Use in medicine
  - Diagnosis
  - Validation of treatment efficacy
- Use in sports
  - Technique optimization
  - Injury prevention
- Use in entertainment media
  - Record actors performing actions to overlay computer graphics on (CGI)

What systems are available?

State of the art

Vicon motion capture system here at Texas A&M (Zachry common labs)

- $60,000 system
  - 7 motion capture cameras
  - 1 video camera
  - 2 force plates
  - Data analysis software

Propose Motion Capture System

- Utilizes smartphone cameras
- Motion analysis in easy manner
- More portable, accessible, and affordable compared to currently available MoCap systems
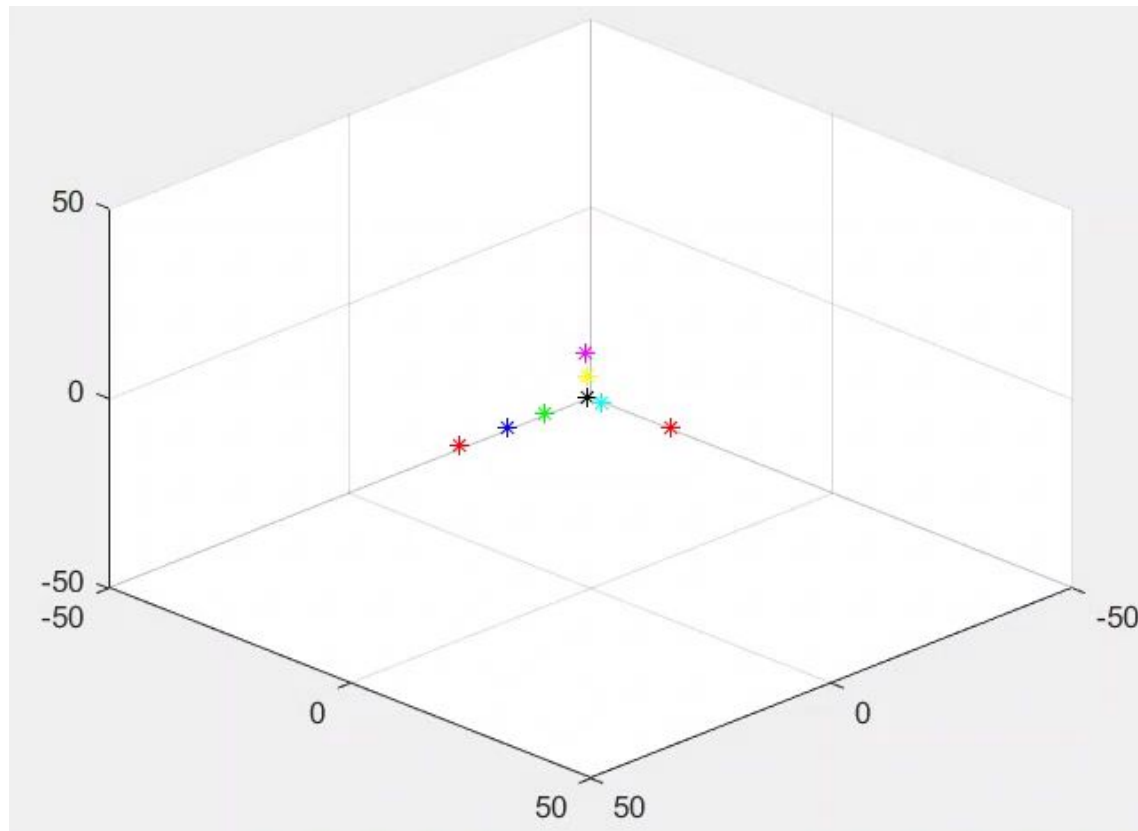
Proposed Method

A low cost alternative to state of the art

# Calibration: Stationary Points

Direct Linear Transformation (DLT)

- Method for determining the 3D location of objects using two or more views

- Provides relationship between world data space and each camera's coordinate plane

- Requires known points for calibration

- Utilizes sets of similar relations derived from known points to solve for variables

Two Cameras (minimum) and a Reference Frame

- Each camera provides 2D position data
- 3D position is obtained by combining two 2D position data sets
- Reference frame allows for cameras to be positioned where space allows, as long as their location remains constant after calibration

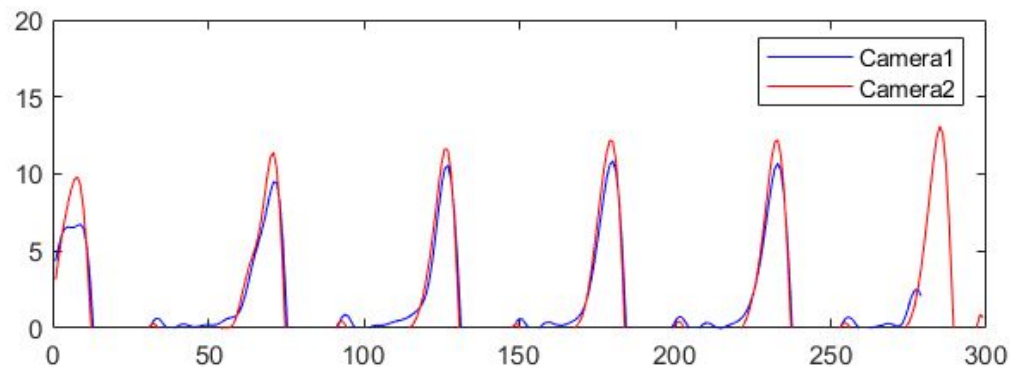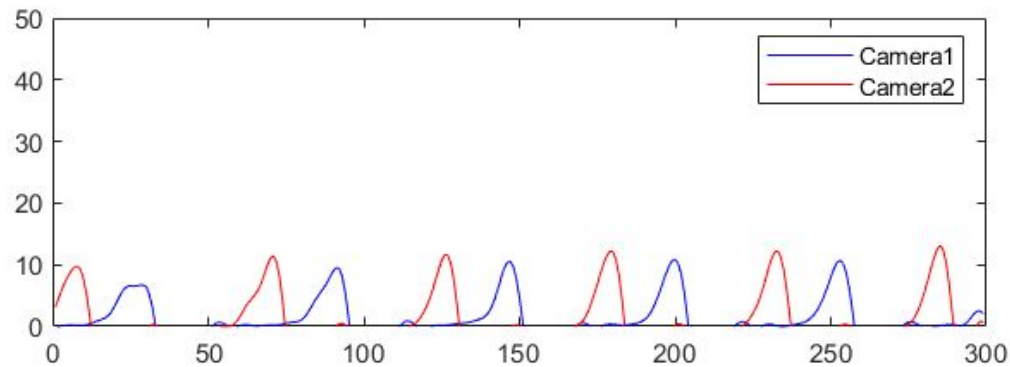# Treadmill Walking Experiment
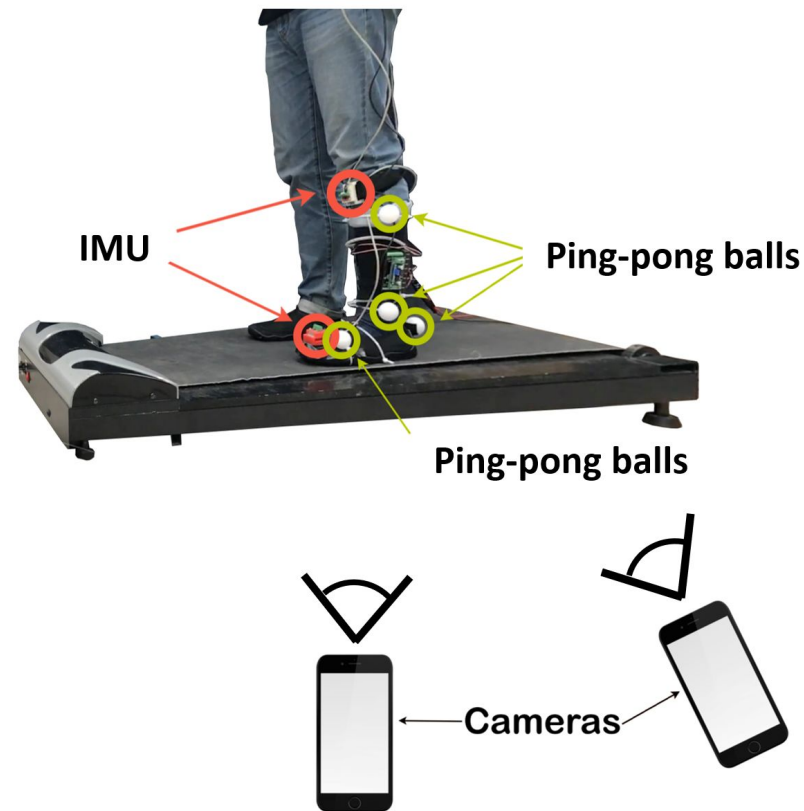
Data Validation

- Uses motion tracking software to track motion data of each data point
- Calculates joint angles with motion data obtained
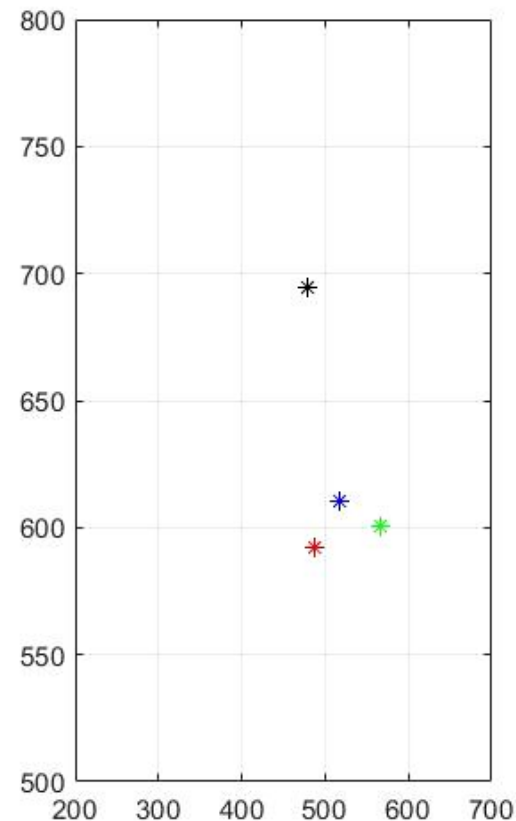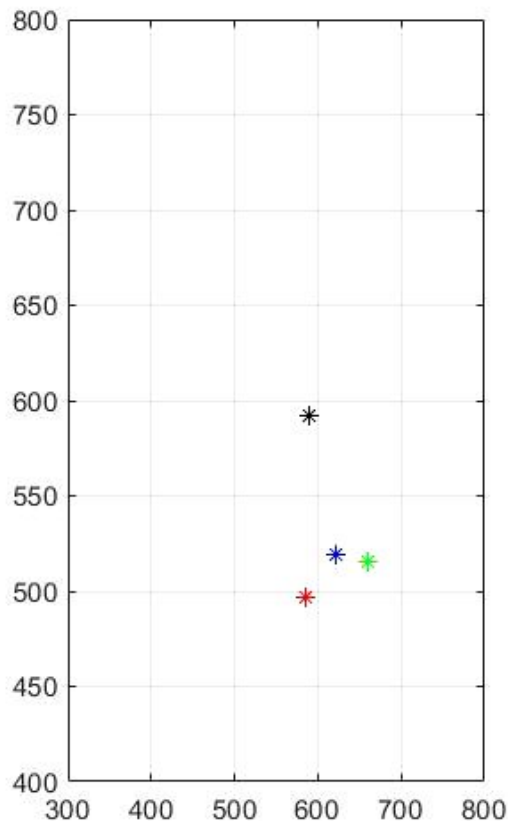- Compares our MoCap system result with the result from IMU system

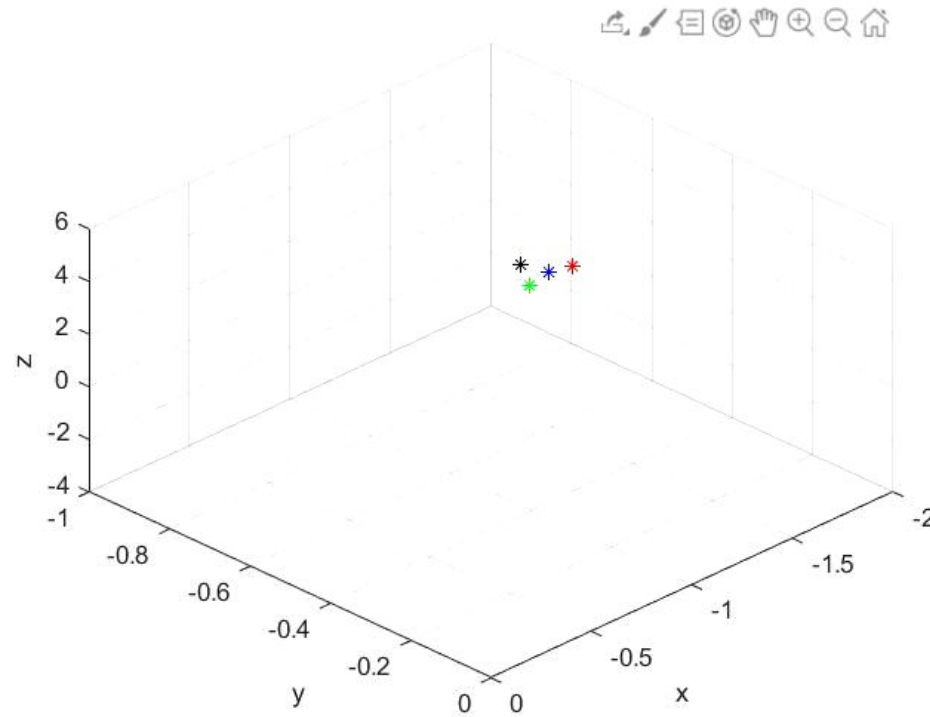# Tracking Video

Data Synchronization
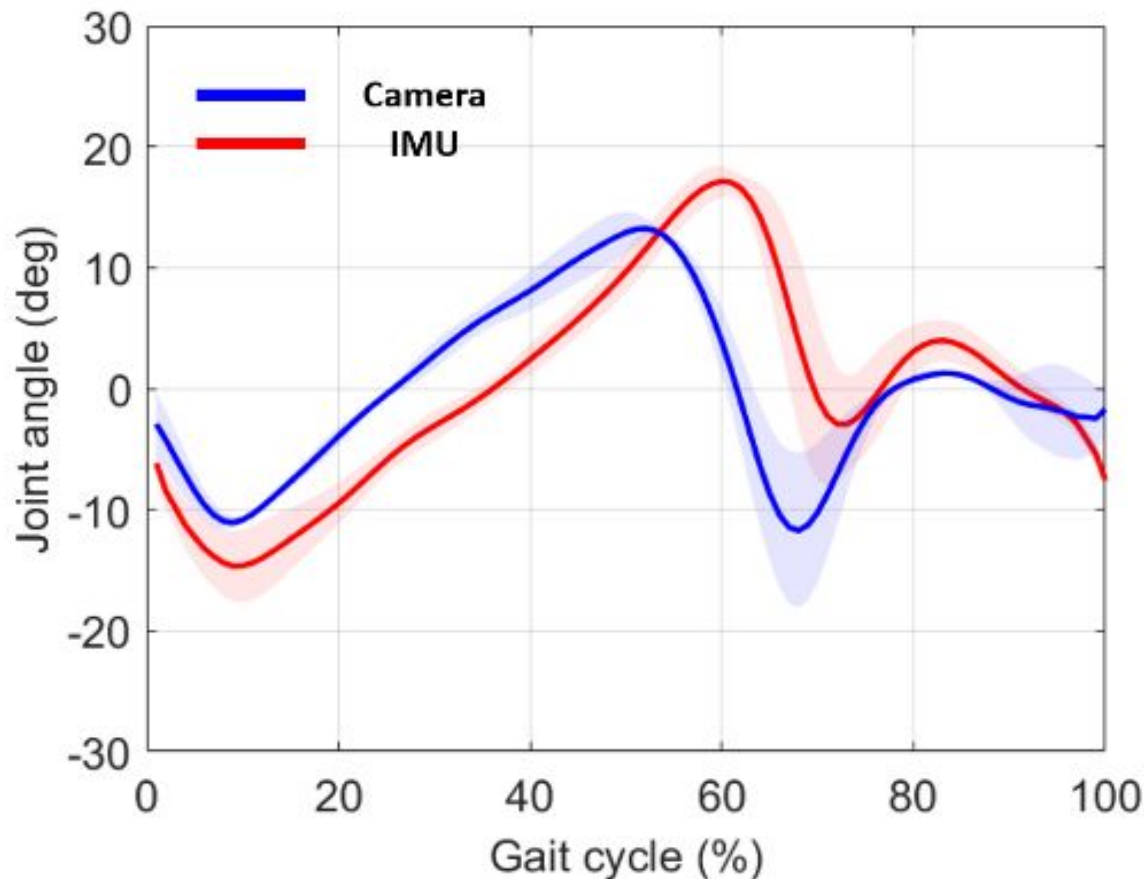
Synchronized Motion (2D)

3D Reconstructed Motion

Ankle Joint Estimation Comparison

Discussions

- Comparison of ankle joint angles in the sagittal plane

- Confirms preliminary feasibility

- Qualitatively similar trend for the entire gait cycle

Future Plans

- Improve the tracking algorithm
- Develop a smartphone application that makes use of the system
- Full body motion capture
- Compare with industry level systems
- Share this work to the public (GitHub)

Thanks for watching

References

Nitisharma, and Leverton. "3D Motion Capture System Market Technology Used and Future Scope Report 2022." Area, December 4, 2017.

Discussions

Results

Where do we go from here?

Proposed MoCap System

Experiment Protocol