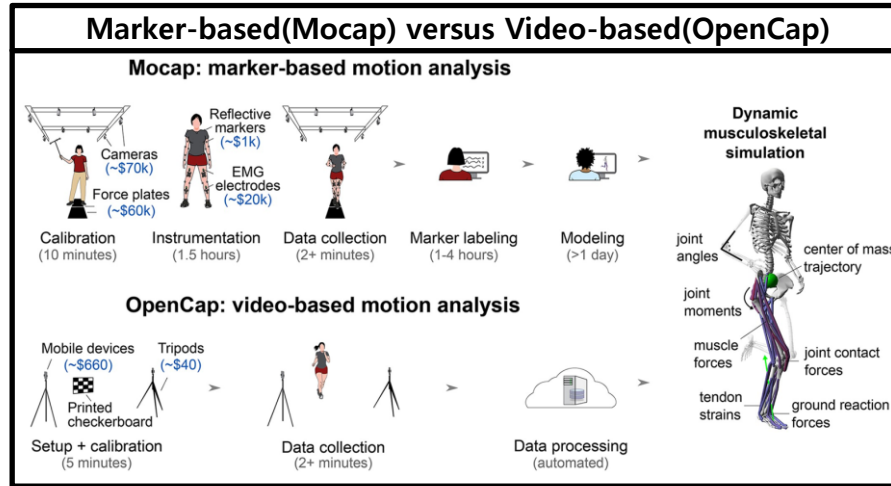# Kinematic Data Analysis using OpenCap

Presentation Date : 25.7.2
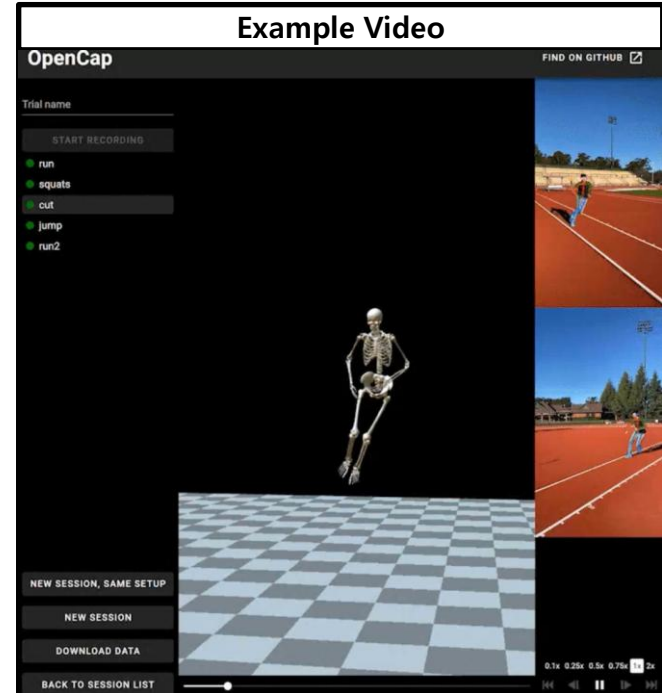
Presenter : Dongwoo Kim

What is OpenCap

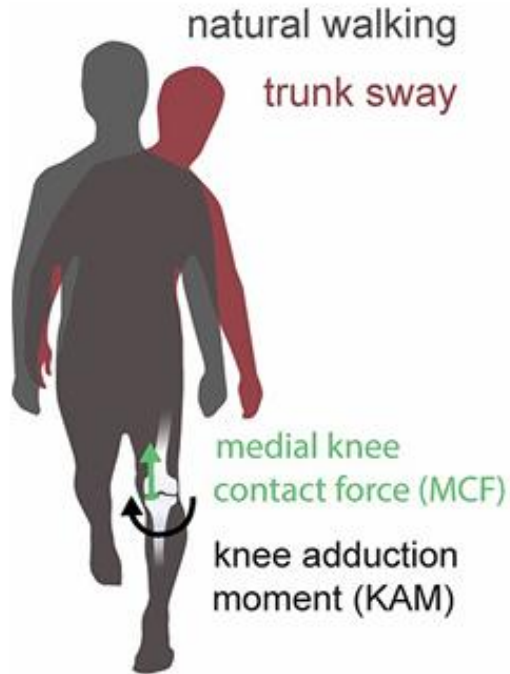**OpenCap** : Motion Capture analyzes Human Movement Dynamics from two smartphone videos

Marker-based(Mocap) versus Video-based(OpenCap)

➡️ **OpenCap : Low Cost & Less Time**

Example Video

Image Source : [Paper] OpenCap: Human movement dynamics from smartphone videos

Vedio Source : https://github.com/stanfordnmbl/opencap-core

Performance Validation of OpenCap

Knee loading during walking

Kinetic differences during sit-to-stand

Source : [Paper] OpenCap: Human movement dynamics from smartphone videos

Performance Validation of OpenCap

Muscle activation asymmetry during squatting

asymmetric squat
natural squat

vasti muscle
activation

Asymmetric Squat Example Video

cam0 cam1 OpenCap Result
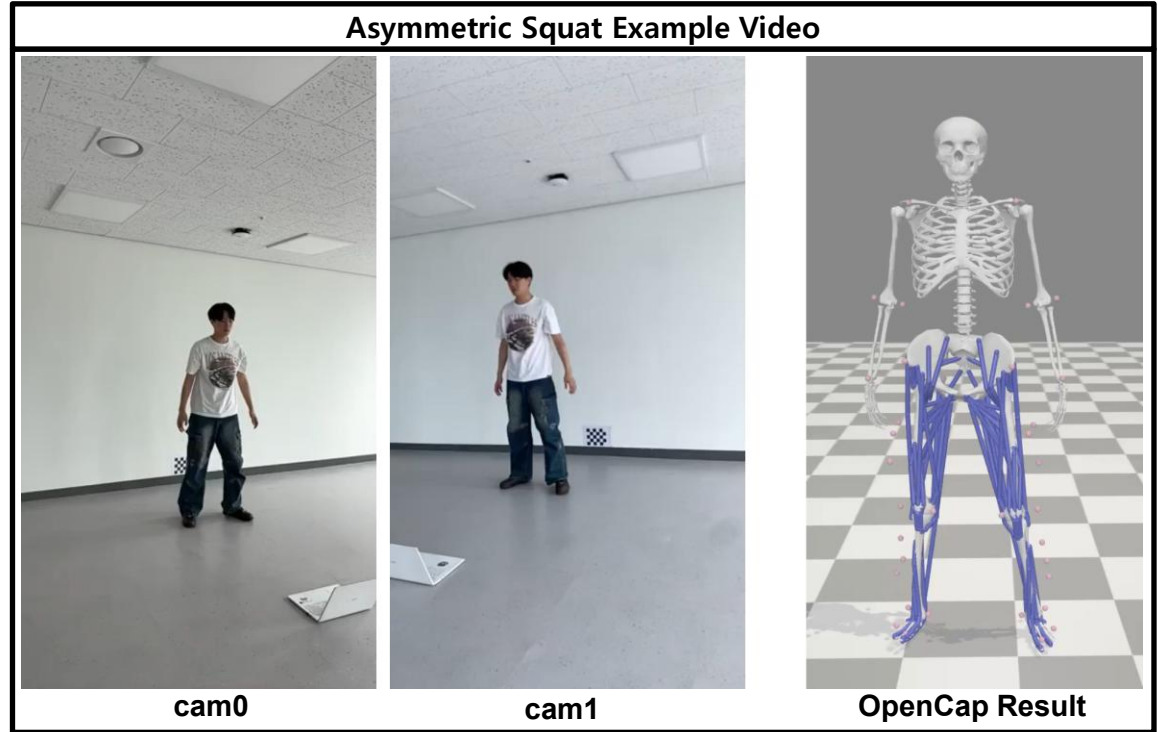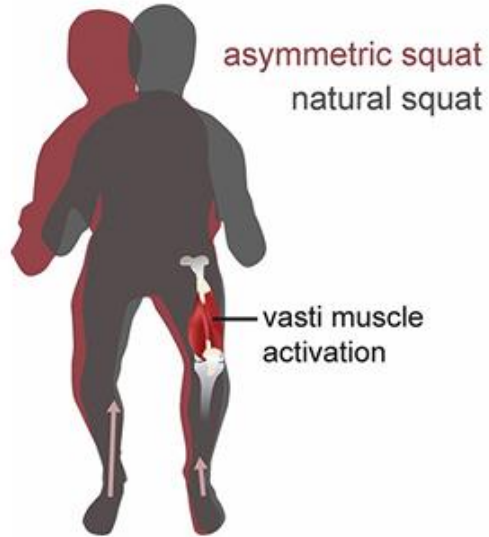
OpenCap Pipeline

OpenCap Pipeline

| cam0 | cam1 | | cam0 | cam1 |

Simultaneous Video Capture → **2D Keypoints** → **3D Asanatomical Markers** → **Kinematics** → **Dynamics**

OpenPose

Triangulation

LSTM

OpenSim IK Solver

Muscle-driven Tracking

3D Keypoints

Image Source : [Paper] OpenCap: Human movement dynamics from smartphone videos
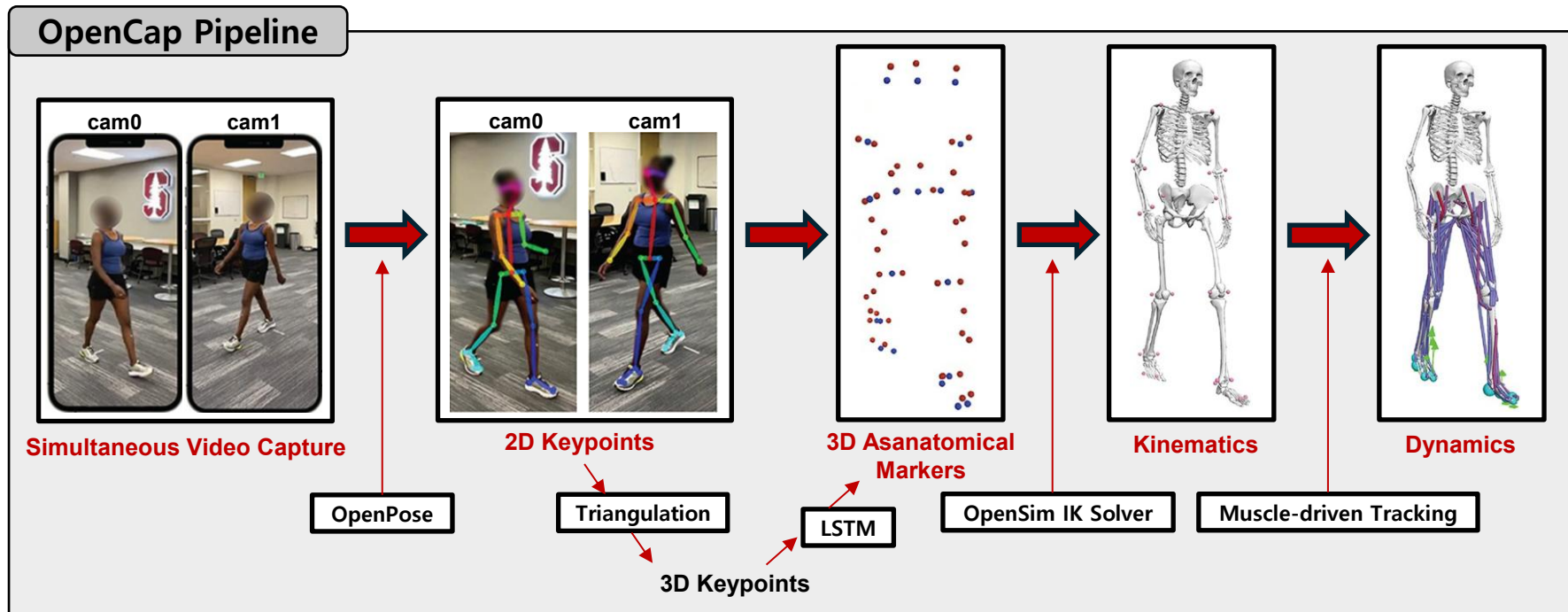
OpenCap Experiment 1 : 2 Cameras
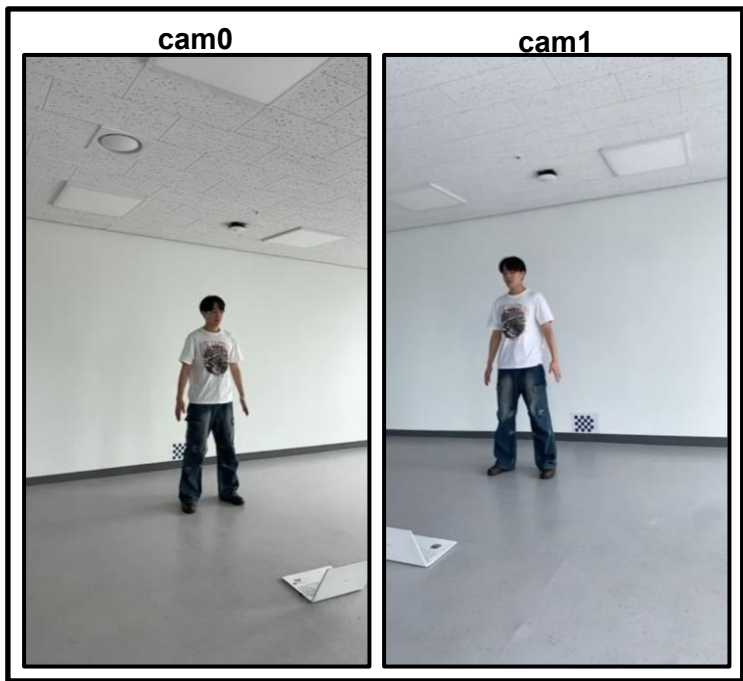
Motion : Squat

Simultaneous Video Capture
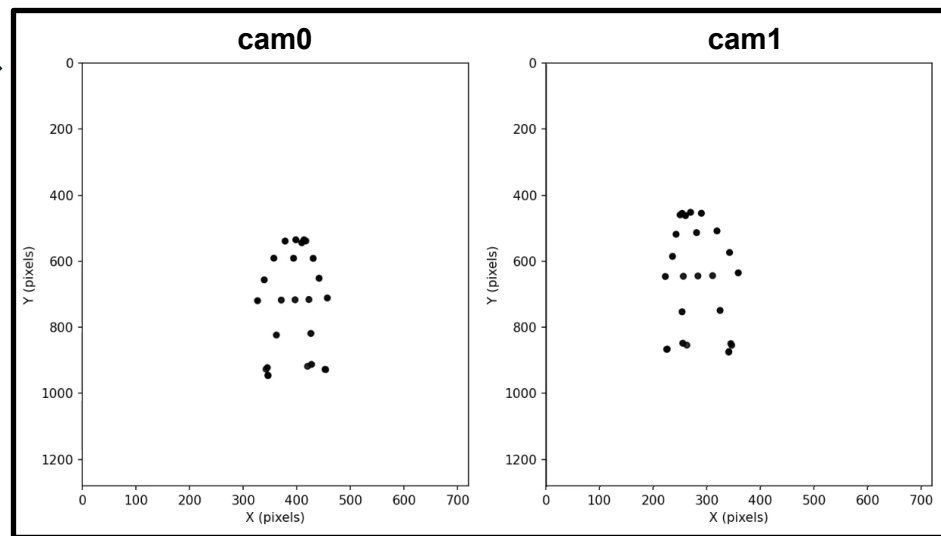
2D Keypoints

OpenCap Experiment 1 : 2 Cameras

Motion : Squat
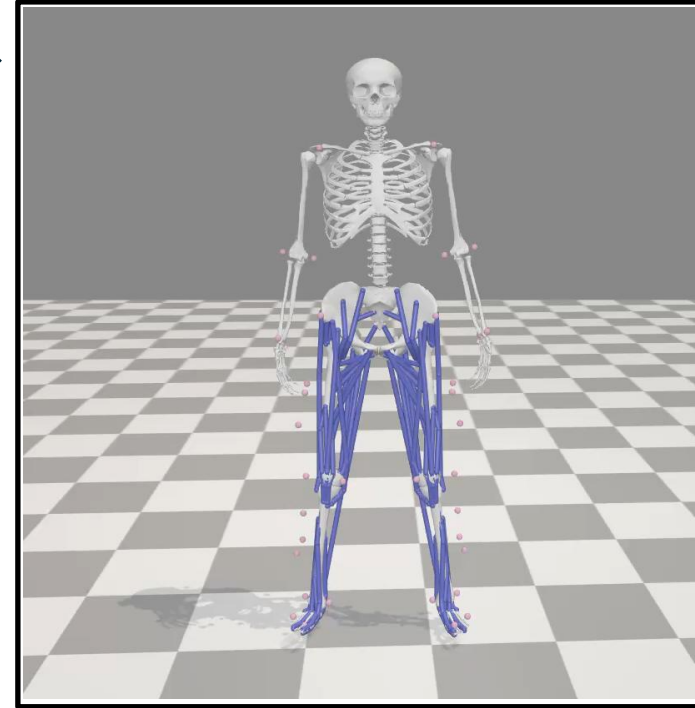

3D Asanatomical Markers

LSTM

3D Keypoints

Triangulation
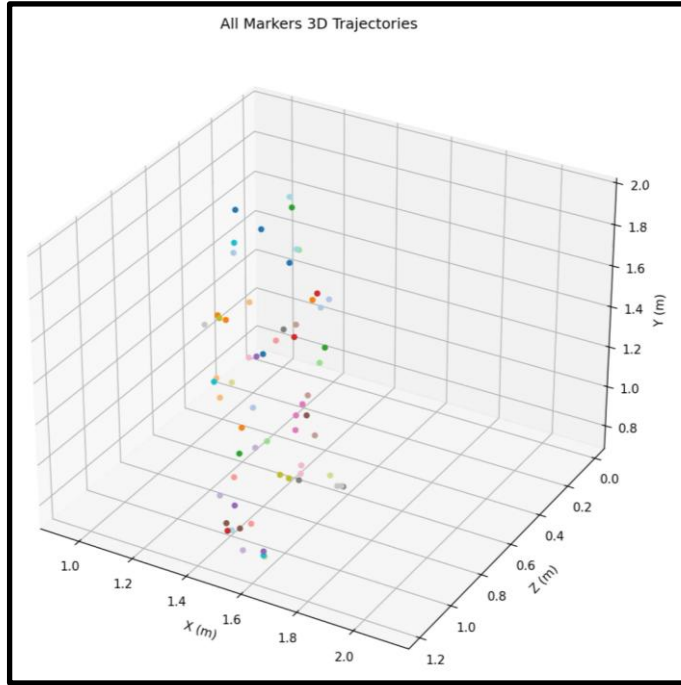
OpenSim
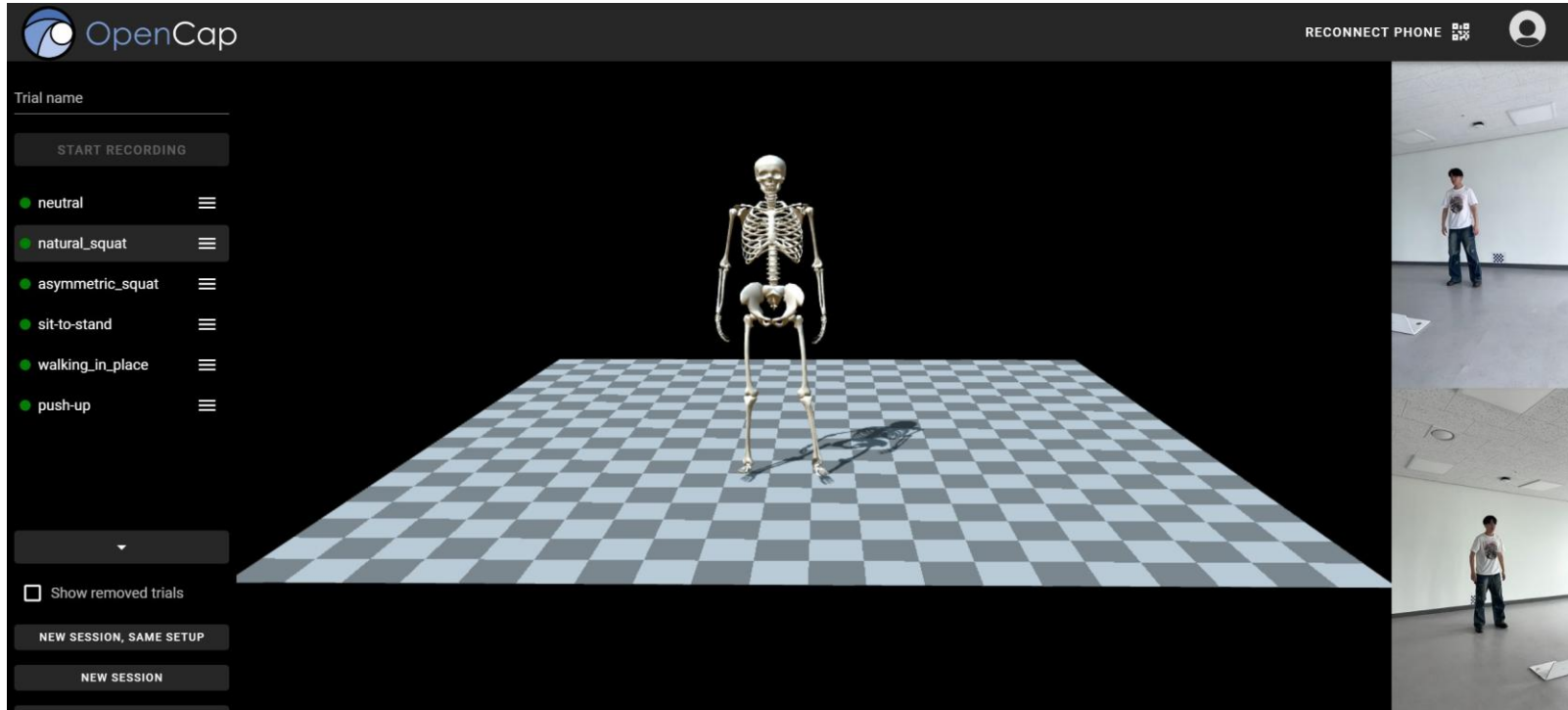IK Solver

Kinematics

OpenCap Experiment 1

Motion : Squat

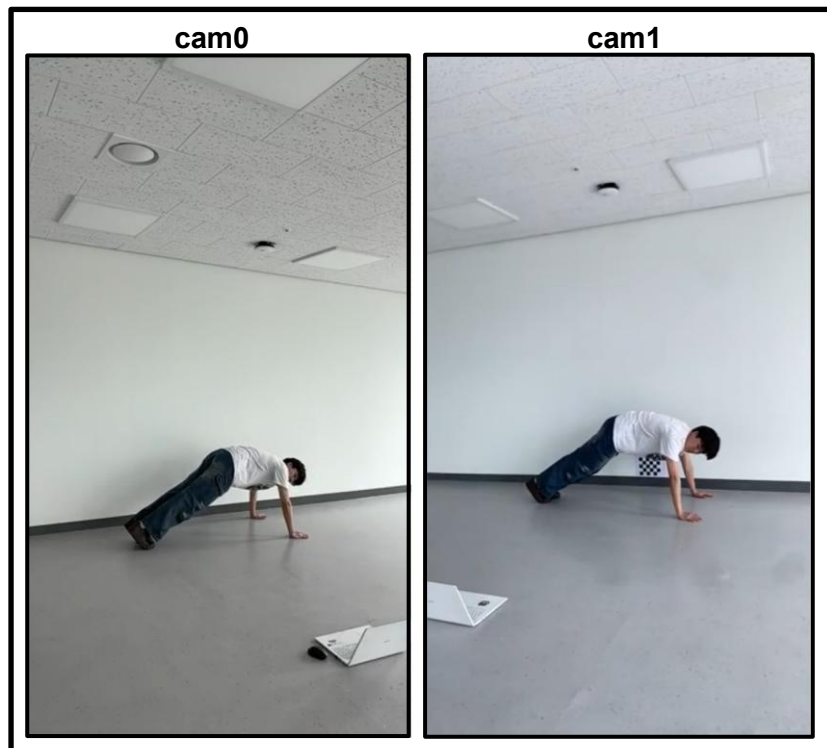**Kinematics Data from the OpenCap Website**

OpenCap Experiment 1
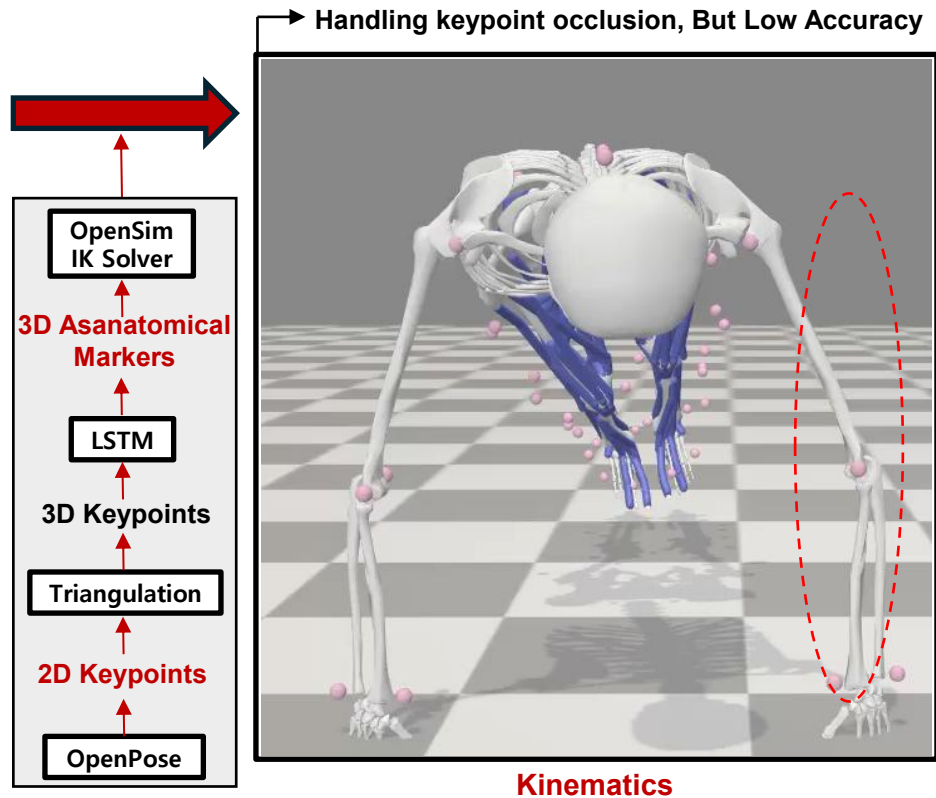
Motion **: Squat**　　　　**Kinematics Data from the OpenSim**

Joint Kinematics Data
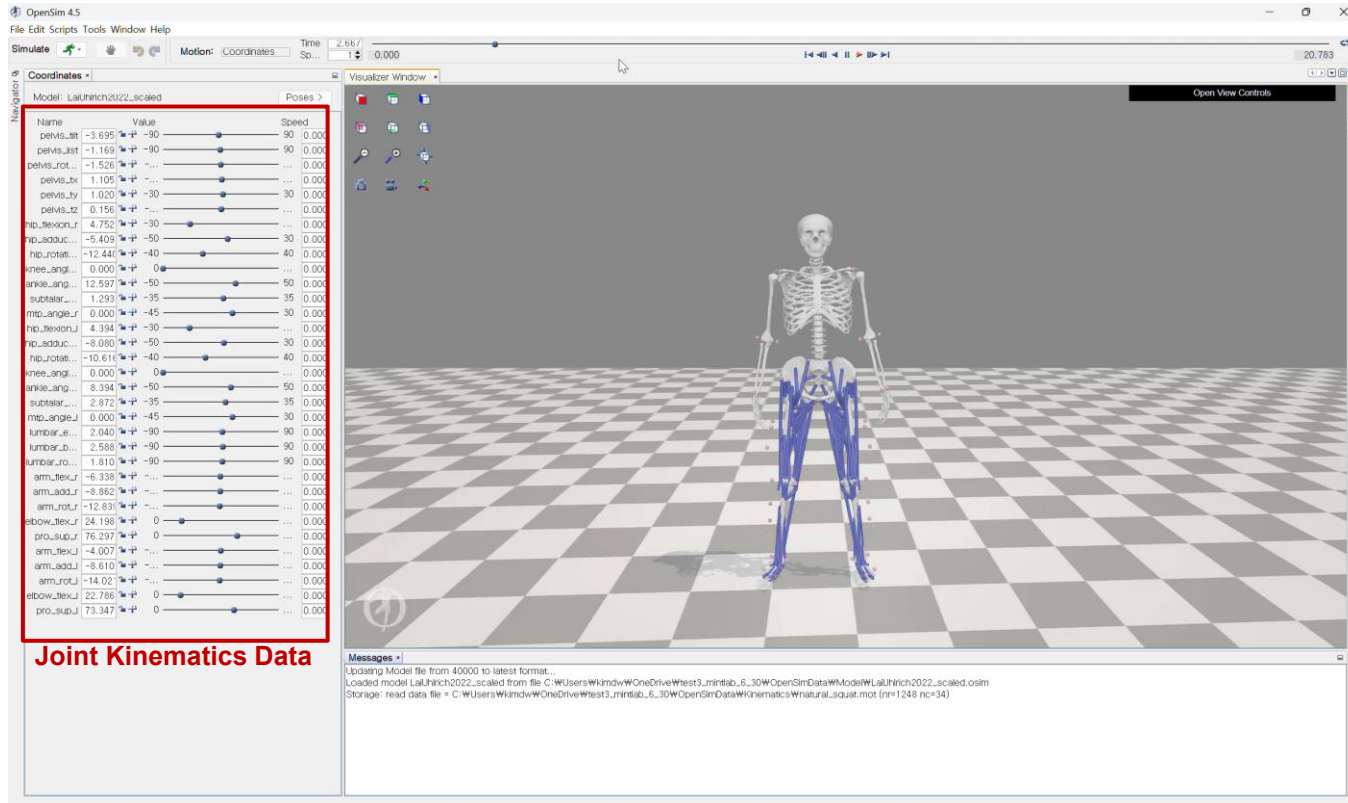
OpenCap Experiment 1

Motion : Push-up

cam0   cam1

Simultaneous Video Capture

OpenSim
IK Solver

**3D Asanatomical
Markers**

LSTM

3D Keypoints

Triangulation

2D Keypoints

OpenPose

Handling keypoint occlusion, But Low Accuracy

Kinematics

OpenCap Experiment 2 : 3 Cameras

Motion : Push-up

Simultaneous Video Capture

cam2   cam1   cam0

OpenSim IK Solver

3D Asanatomical Markers

LSTM

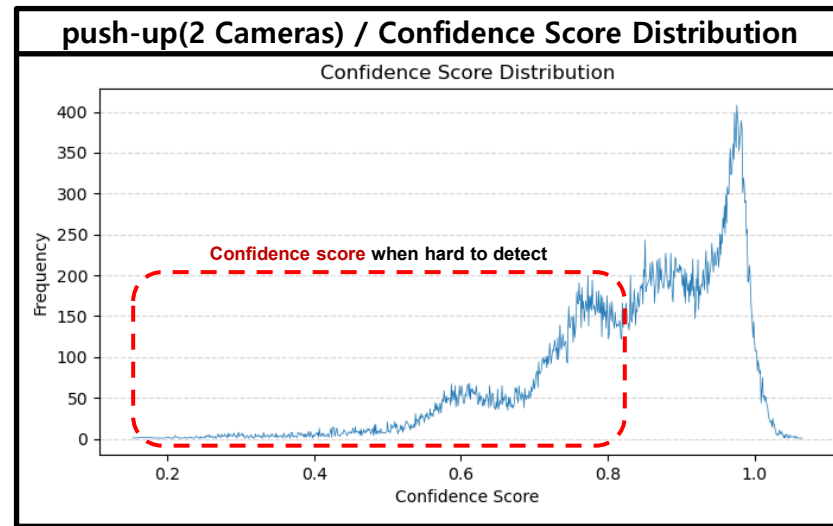3D Keypoints

Triangulation

2D Keypoints
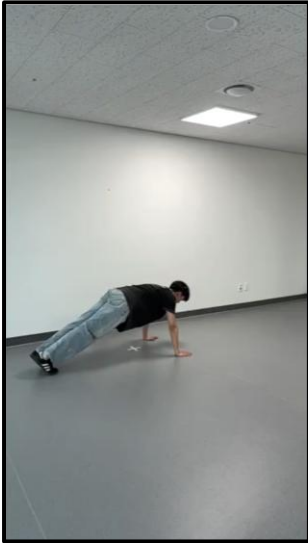
OpenPose
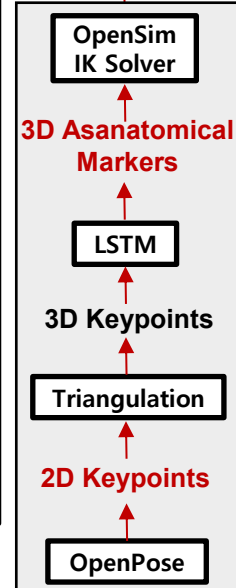
Accuracy has improved
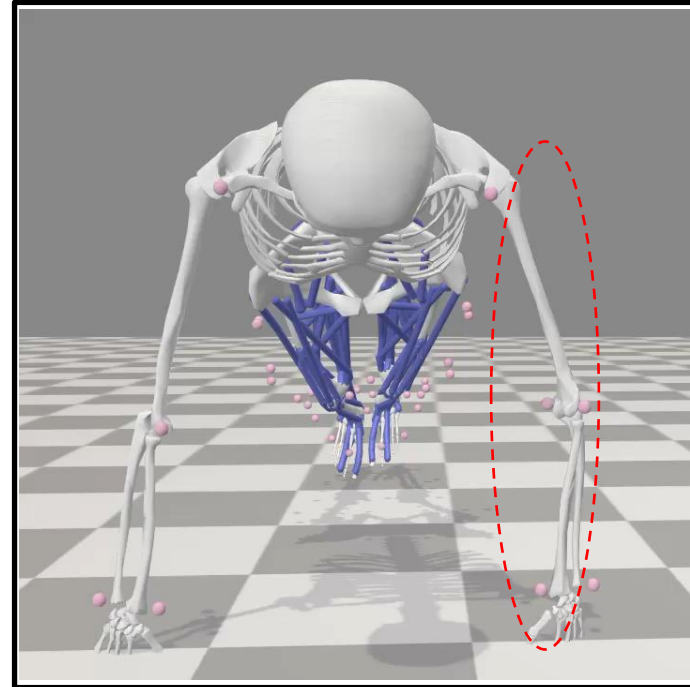
Kinematics

Advantages of Using More than 2 Cameras

cam0   cam1

Input : Image

OPENPOSE

cam0   cam1

output :
2D Keypoint
Confidence Score(0~1)

Triangulation : weighted by Confidence Score

3D Keypoint

---

push-up(2 Cameras) / 2D Keypoint & Confidence Score

Transparency : Confidence Score

Red Points : Confidence Score < 0.8

---

push-up(2 Cameras) / Confidence Score Distribution

Confidence Score Distribution

Confidence score when hard to detect

Advantages of Using More than 2 Cameras

push-up(3 Cameras) / 2D Keypoint & Confidence Score

Transparency : Confidence Score
Red Points : Confidence Score < 0.8

Accuracy can be improved because Pose Estimation can be performed with various views.
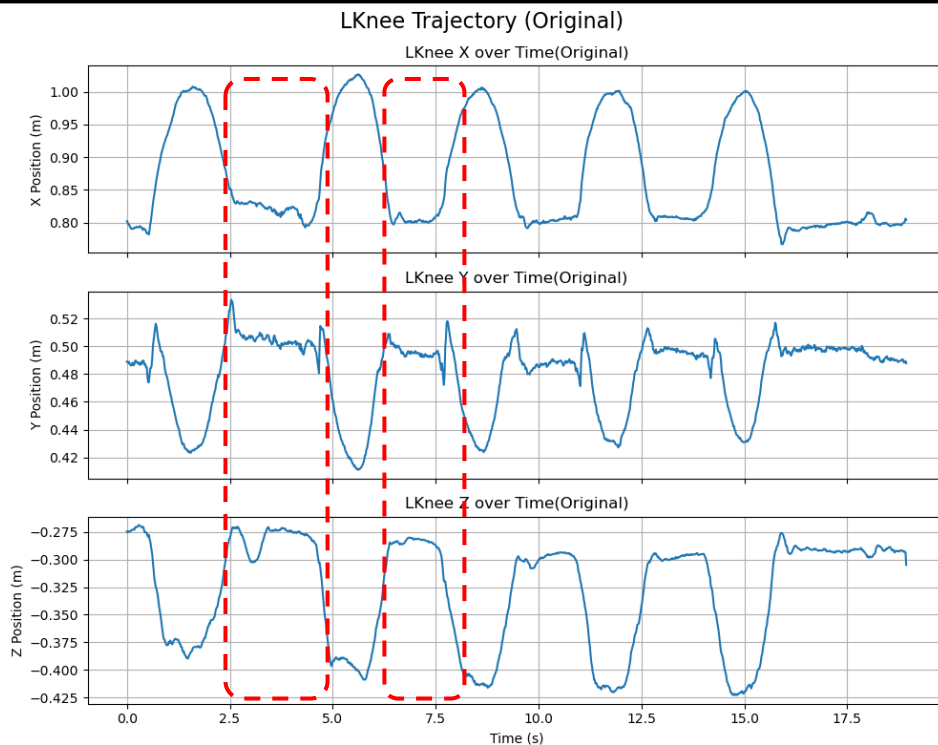
Precautions when using OpenCap

It is advisable for the participant to wear tight-fitting clothing.   **Small Actions are not recommended.**

Joints are hard to detect.
Noise is generated by clothes.

Conclusion : Check the Data is Reliable

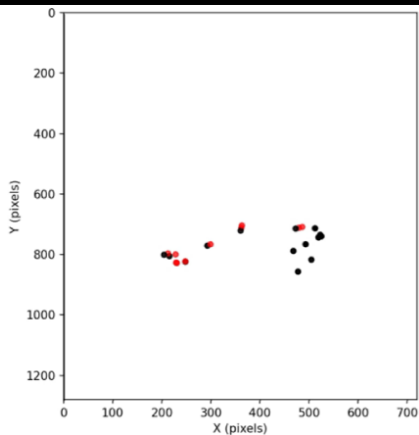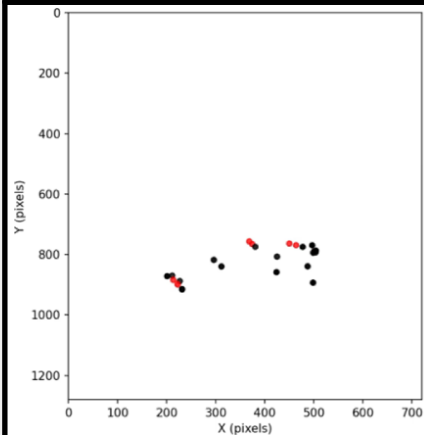## Check the OpenPose Results

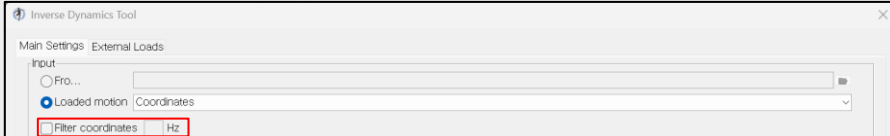**Low** Confidence Score Distribution
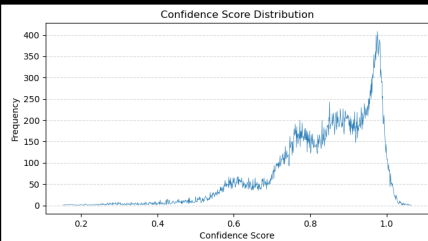
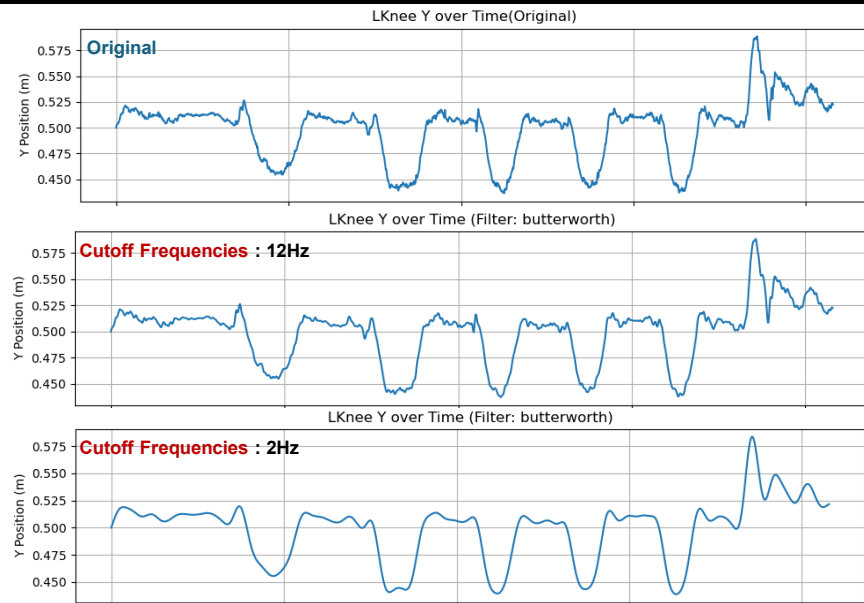**High** Confidence Score Distribution

2D Keypoint & **Confidence Score**

Check the Filter Results before Dynamics

Displacement of 3D Anatomical Markers with Butterworth Filter

Thank You

Presenter : Dongwoo Kim