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Analysing Archer's body Posture with Motion Capture System

Computer Vision

Yesun-Erdene Jargalsaikhan

Introduction

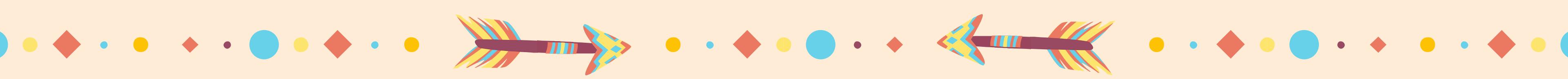
Analysing Archer's body Posture
with
Motion Capture System



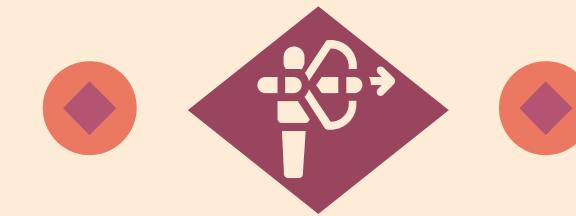


01

Motivation and Background



Motivation



Monitoring

Couch-free training



Performance

Better aiming
Focus on shooting,
not on body



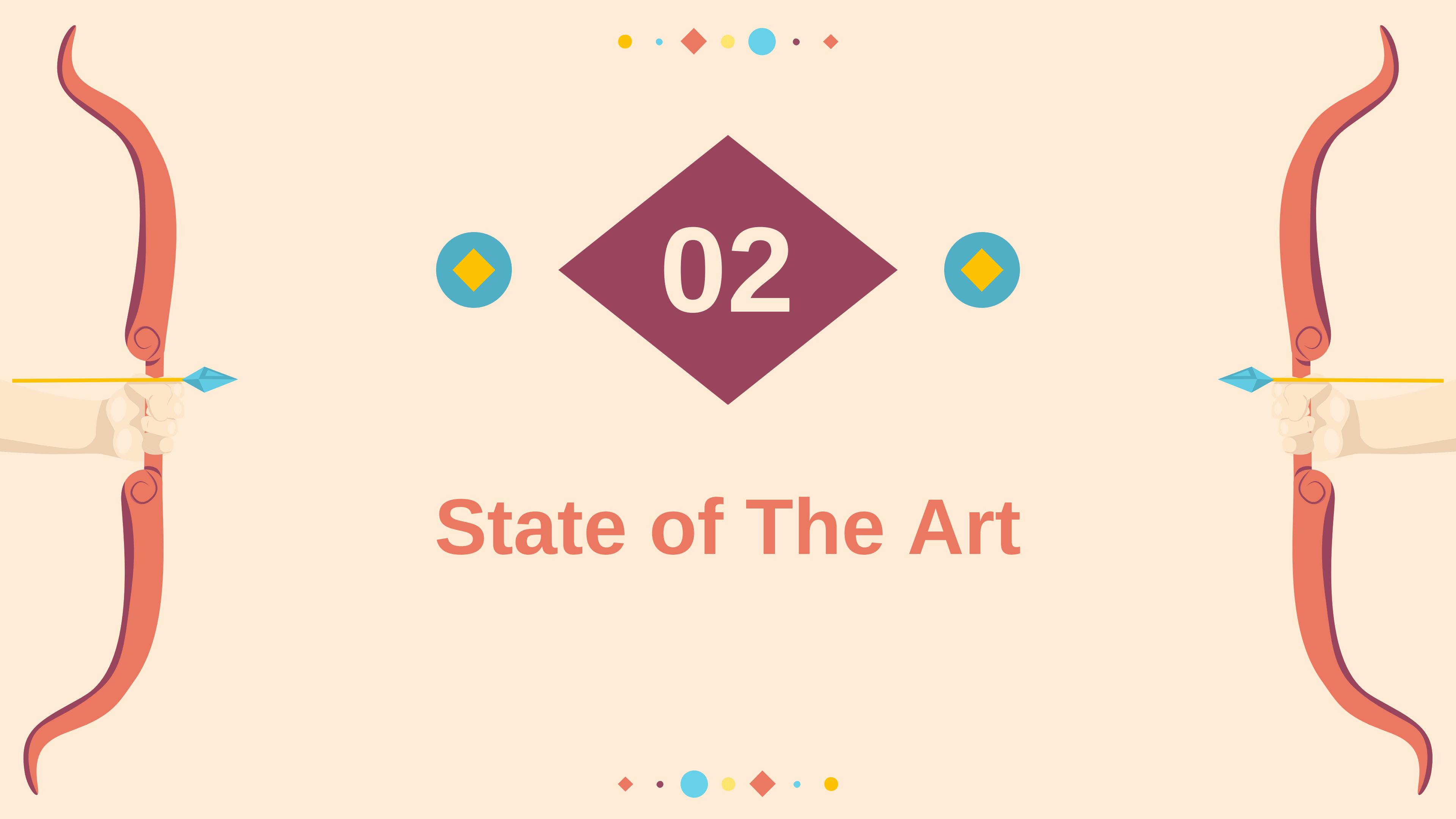
Injury

Prevent from long-term
damages



02

State of The Art



Study of Archery Shooting Phases using Joint Angle Profile

Dar Hung Chiam*, Jonathan Then Sien Phang, King Hann Lim, Basil Andy Lease

Deep Learning Pose Estimation for Kinematics Measurement in Archery

Abstract—Postural consistency and precision in archery. How consistency are often limited by biases and subjectivity. This study explores the use of a deep learning pose estimation model to quantitatively measure shooting. Subsequently, the right elbow, and left wrist during the video frame. Studies show that a shooting session using a joint angle profile can be decomposed into draw, anchoring, transfer, and release phases. The duration of each phase is discussed. The effects and movement in the archery

Abstract—Posture control is crucial in archery to achieve consistent and accurate arrow release on target shooting. Adoption of correct posture and joint motion can prevent undesired movements and effectively reduces rapid fatigue in muscles. By using a markerless motion capture system, it can identify the posture and joint motion of archers between shooting performances without physical capacities with minimal interference on the archer. In this paper, a deep learning pose estimation approach is applied to retrieve joint information of an archer for posture and motion analysis. The posture of professional archers with average age of 17.3 are recorded as the samples for this study. Important parameters and joints, particularly the head, shoulder, elbow, and wrist, and its consistencies are analyzed to study archers' postures and performances. In addition, an algorithm is proposed in this paper to automate the determination of archer's anchoring and release sequence. Several qualitative results of joint kinematic parameters and visualization are presented to further understand the bio-mechanical aspect of archery.

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Deep Learning Posture Estimation for Archery Consistency Measurement

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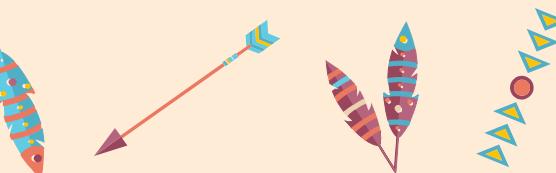
Abstract—Consistency in archer's posture is crucial to retain high precision and high reproducibility in the shooting movement. The current practice in measuring postural consistency is often limited to human visual inspection with biases and subjectivity. First, a camera is used to capture body posture of archer during anchoring. A series of body posture images are subsequently processed with a deep learning pose estimation model with the extraction of keypoints. The selection of joints and keypoints for archery are grouped for postural consistency study during anchoring phase. This paper presents a study between the postural consistency and scoring performance using an automated posture estimation mechanism. The study consists of nineteen elite archers performing ten shots in every session. The posture of each session is recorded to study their joint profile and consistency. It shows that the consistency measures are correlated with the joint profiles. The measure of joint profile and consistency can help coaches and athletes in assessing and improving performance with their training strategy.

Keywords—Posture Consistency, Deep Learning Pose Estimation, Keypoint RCNN, Archery Sports.

I. INTRODUCTION

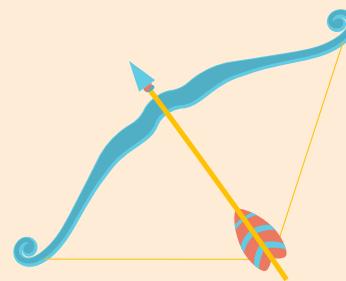
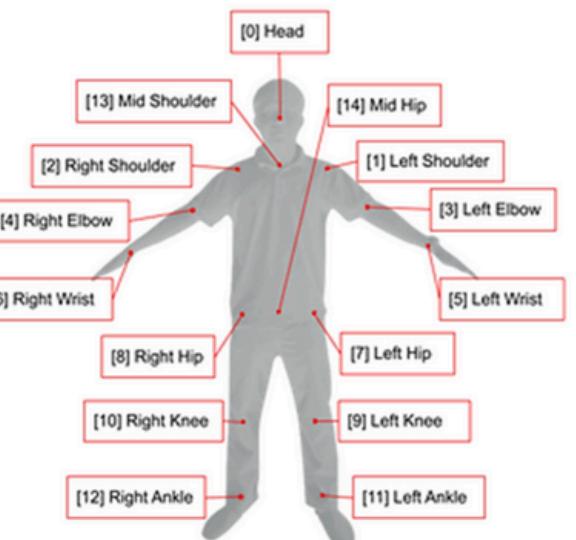
Archery is a precision sport highly relying on their muscle strength and endurance. According to the World Archery Federation (WA),

Deep Learning



discusses the use of deep learning pose estimation in measuring pose consistency in archery shooting. The automation of posture detection allows comprehensive study in archery. The detection of keypoints can quantify the archer's joint profile and subsequently study its posture consistency across multiple shots.

II. DEEP LEARNING POSE ESTIMATION

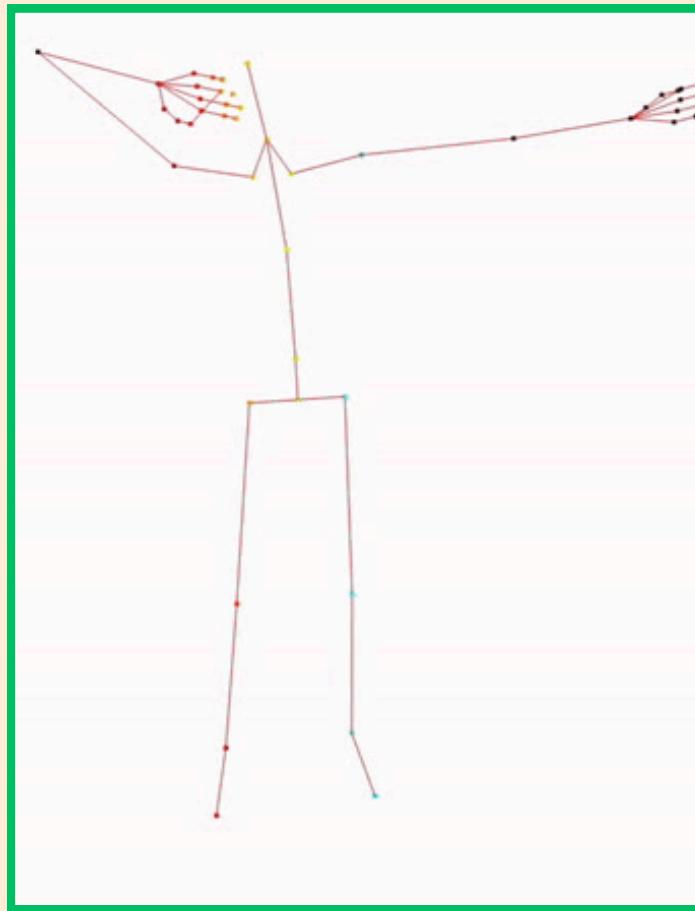




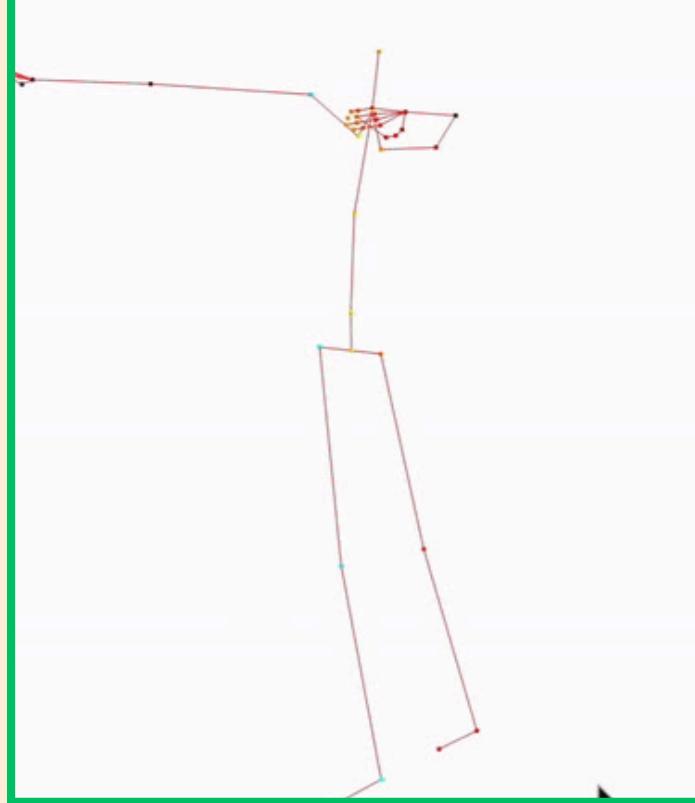
03

Methodology

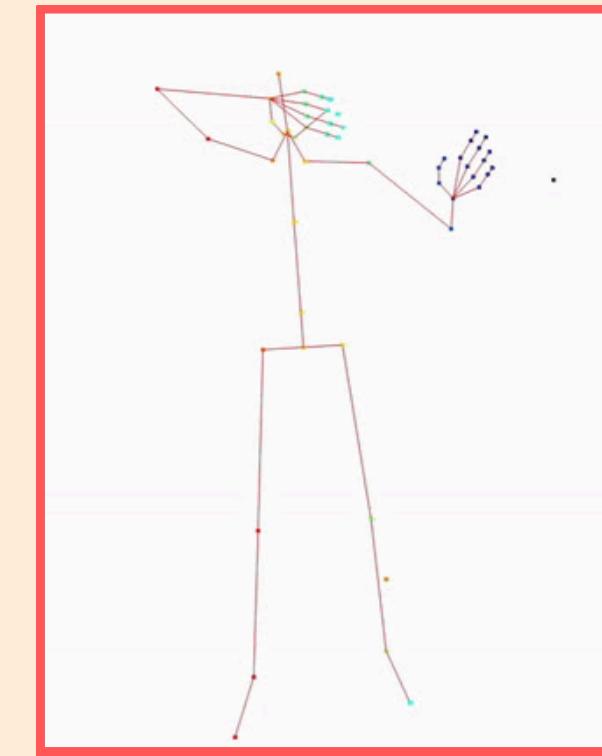
Data Collection



**Correct
(reference)
posture**

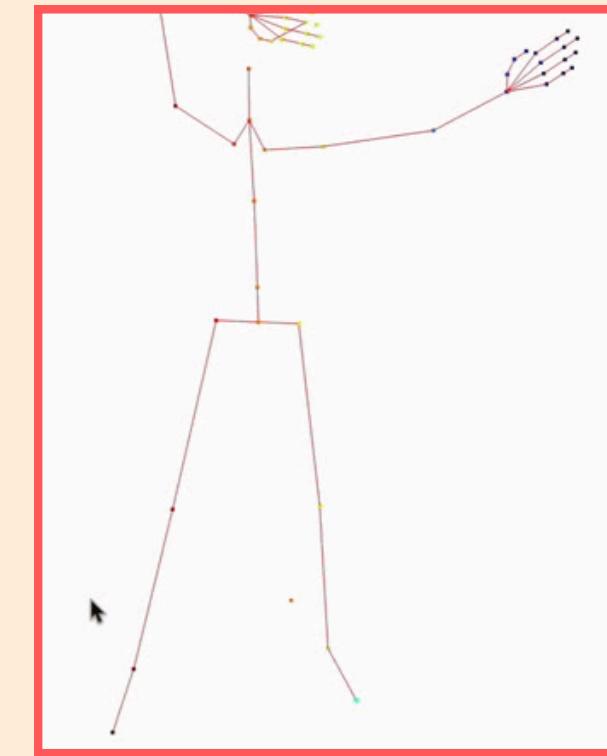


Couch-free traning



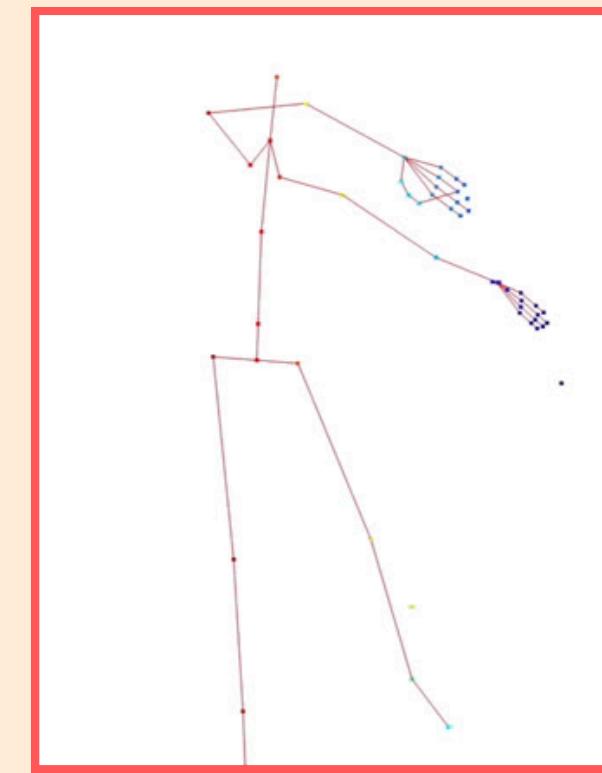
**Shoulder
Raising**

Couch-free traning



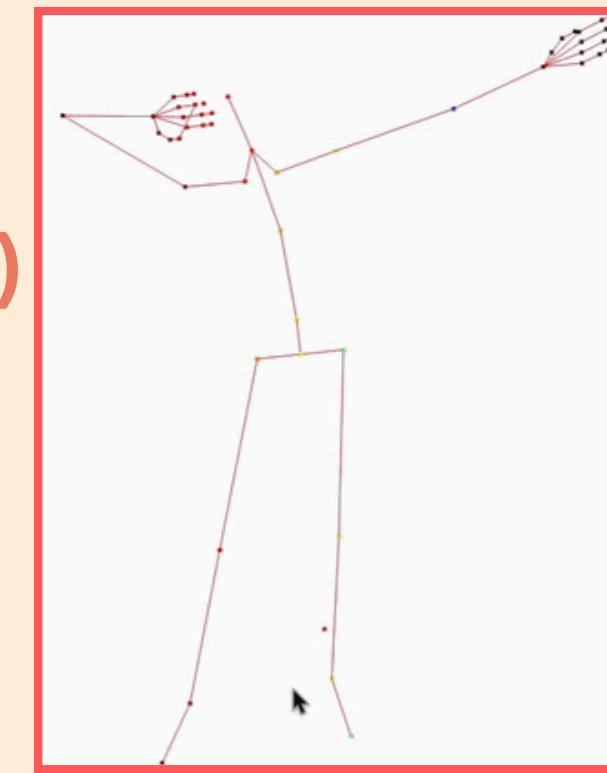
**Exceeded
Feet Distance**

Couch-free traning



**Hips Tilting
(to right side)**

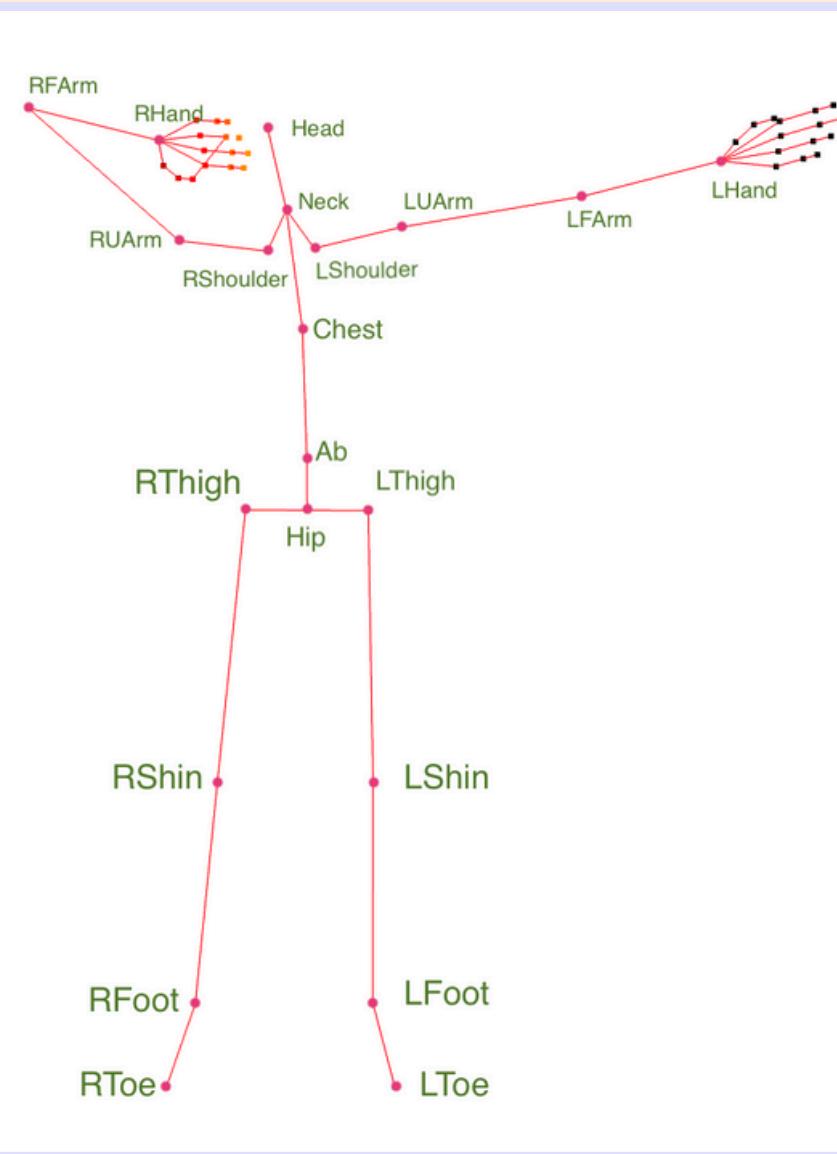
Couch-free traning



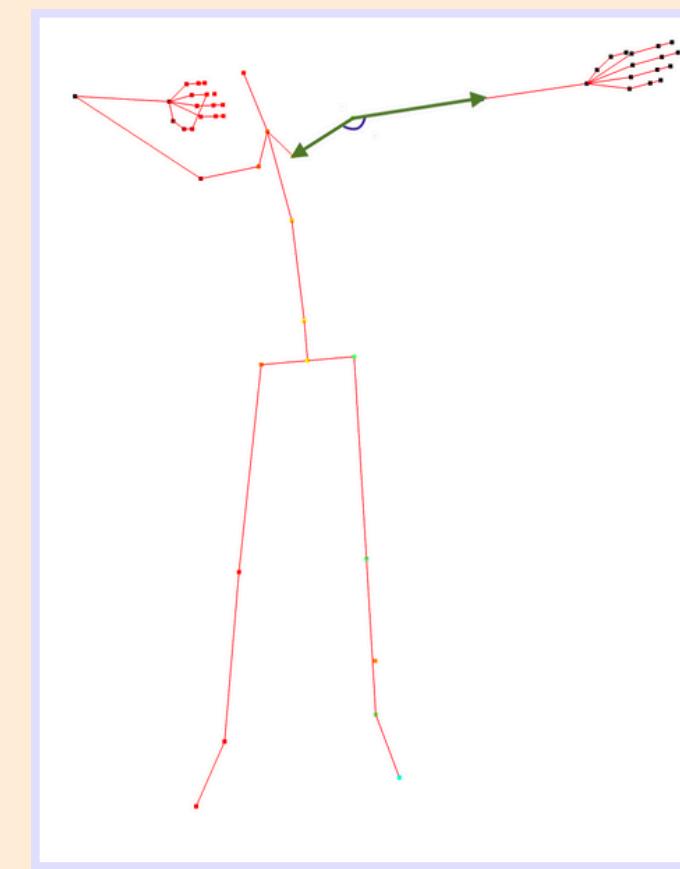
**Hips Tilting
(to left side)**

Couch-free traning

Estimation

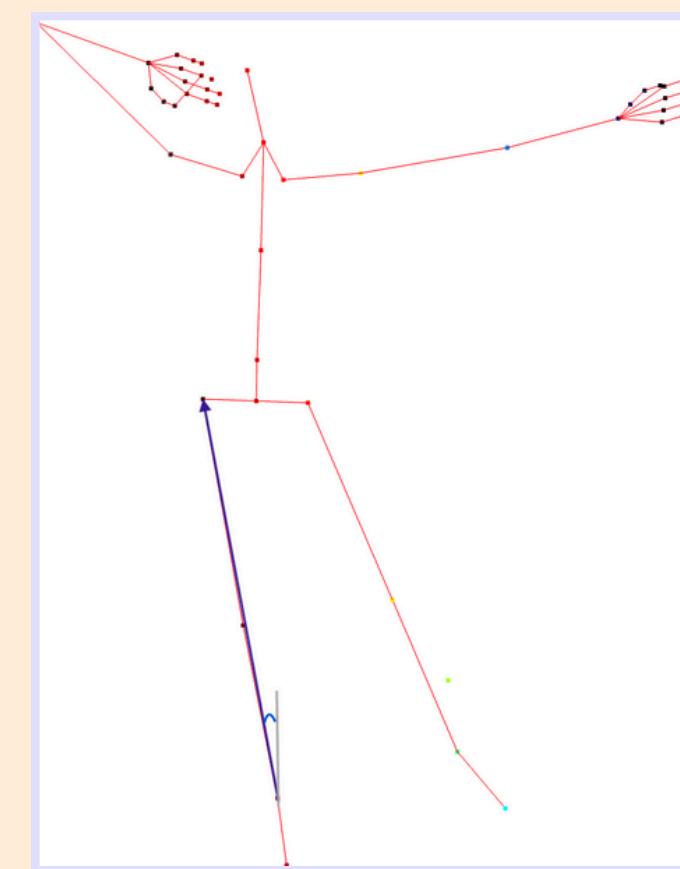


Marker
positions



Angle
between
joint

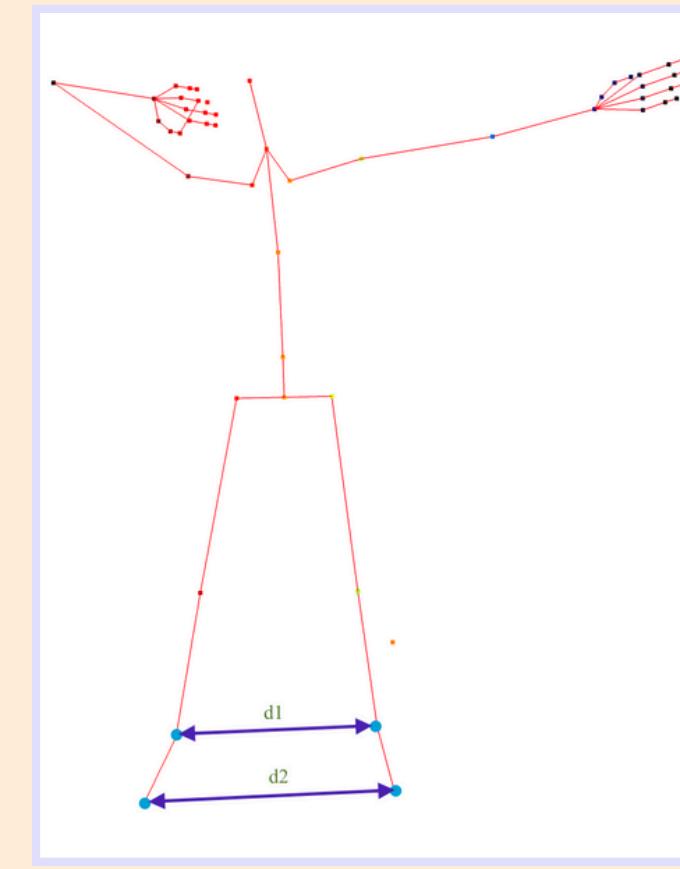
Shoulder v ^ Front arm v



Back leg
tilting angle

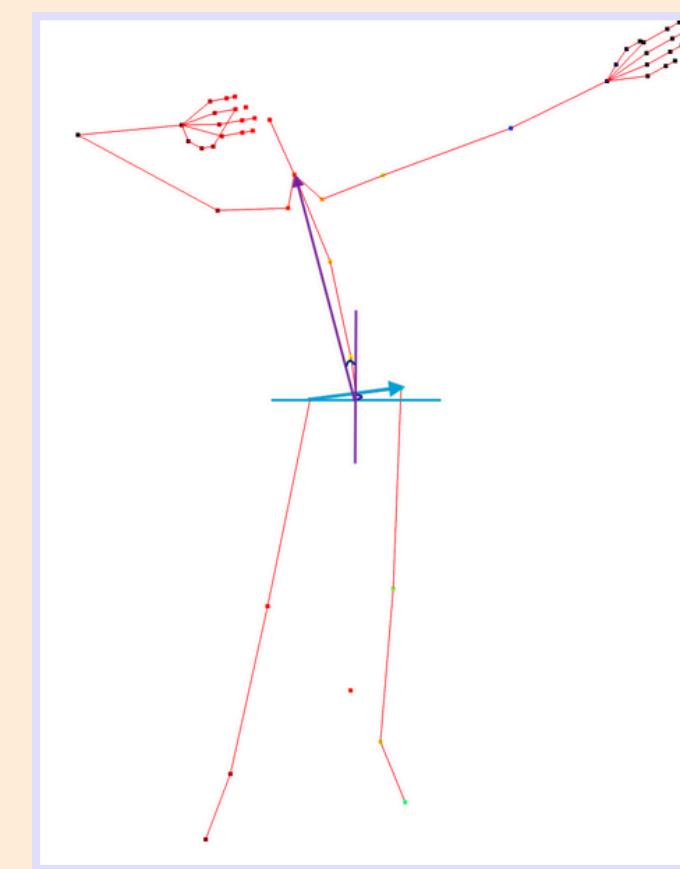
Leg vector ^ Vertical plane

Hips Drop unit
 Δy (hips)



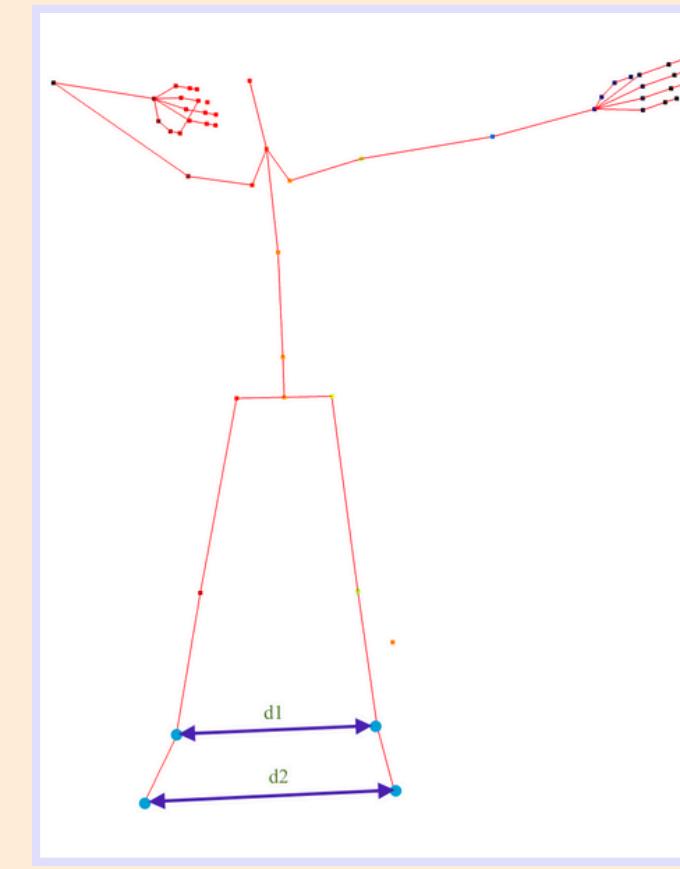
Distance
between feet
and toes

Toes & Feet



Spine tilting
angle

Spine ^ vertical plane



Hips raising
angle

Hips ^ Horizontal plane



04

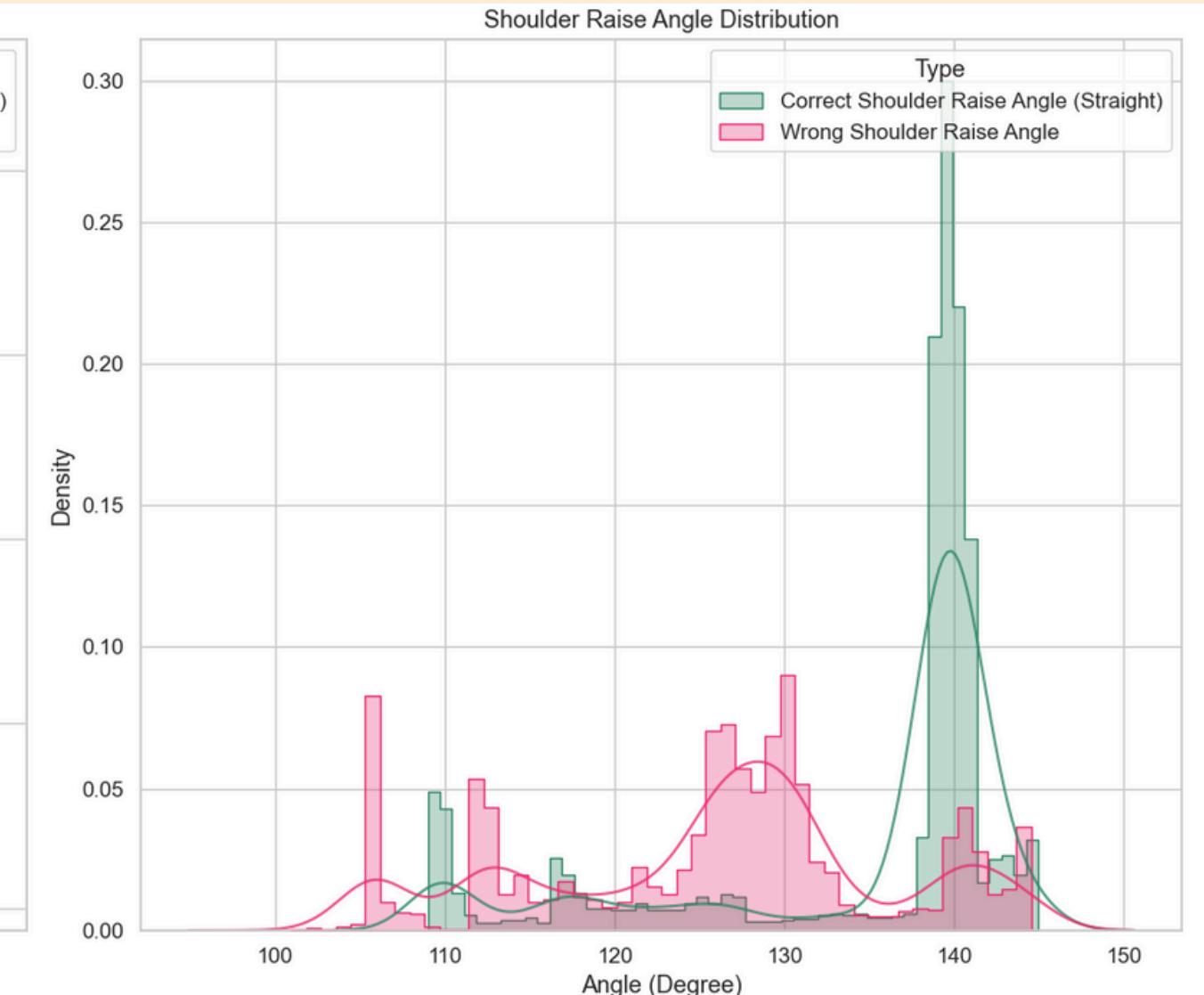
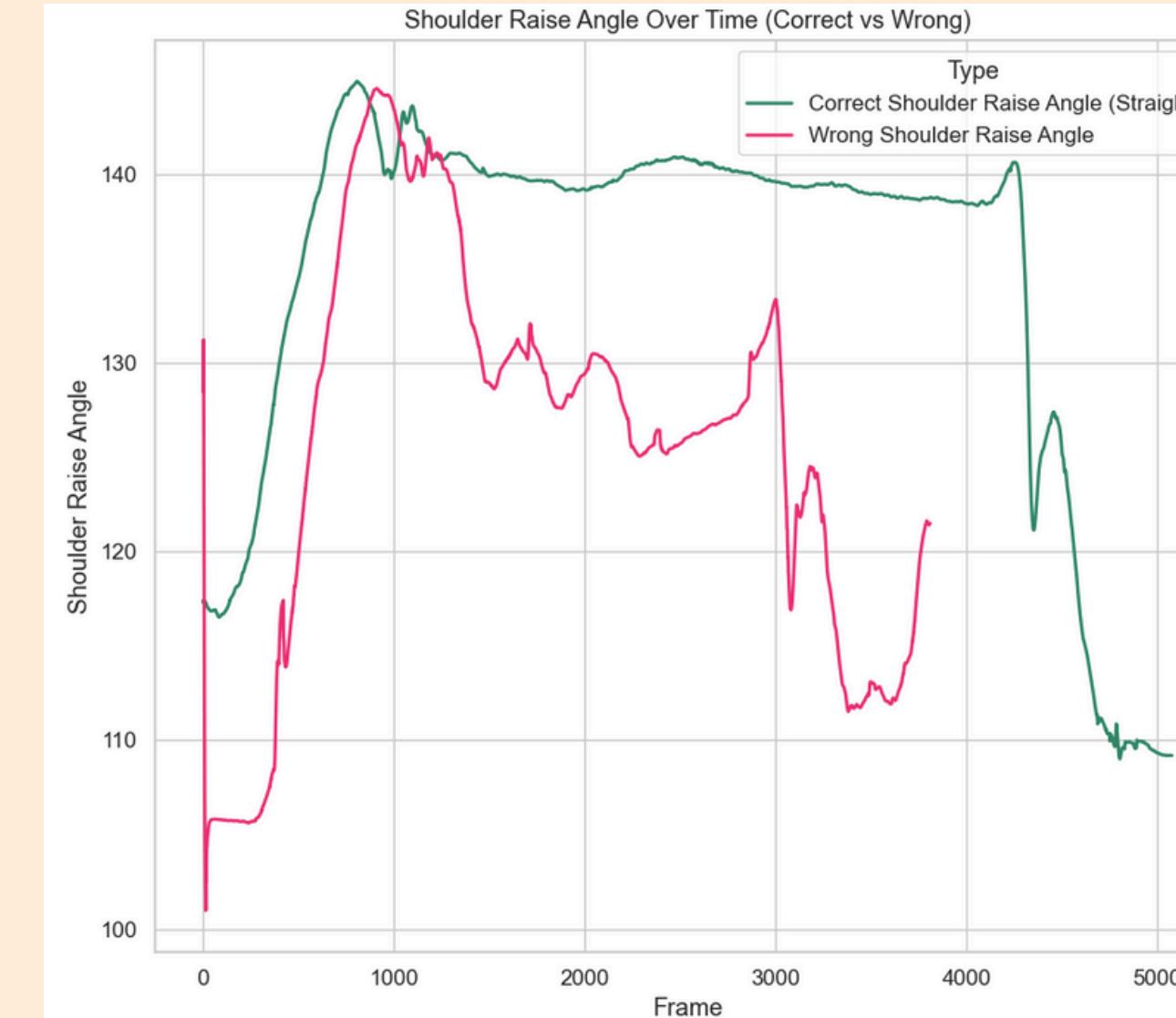
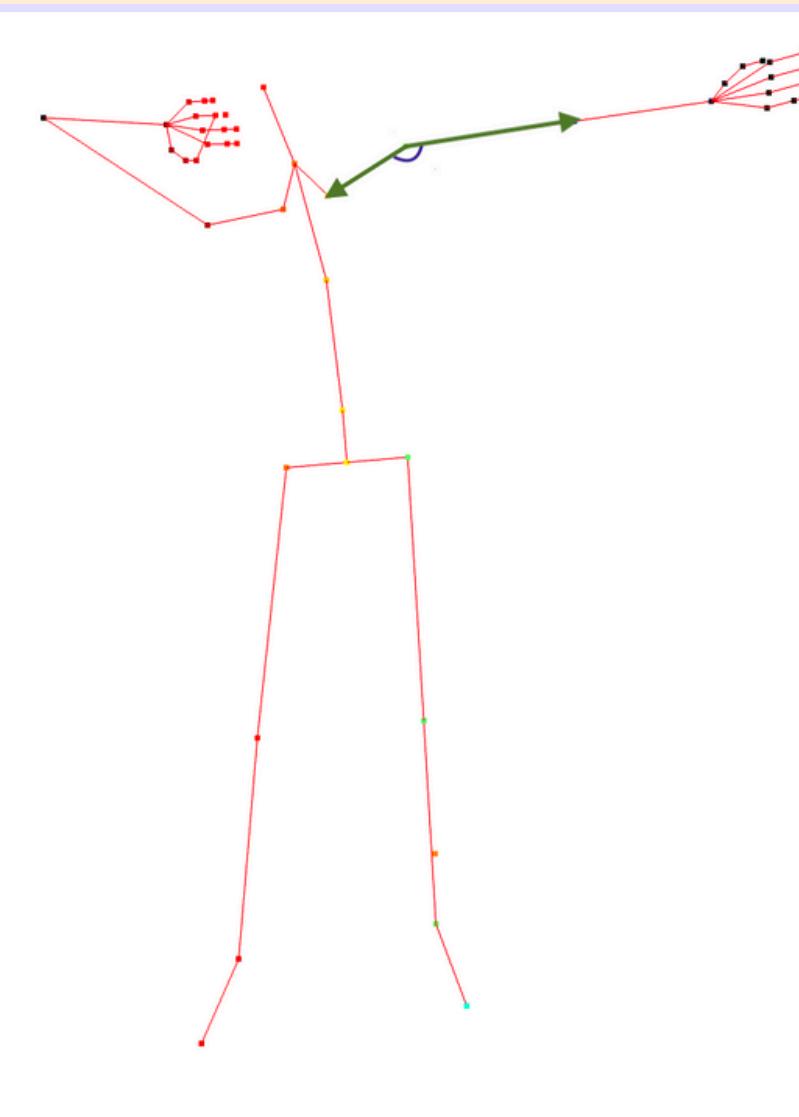
Results



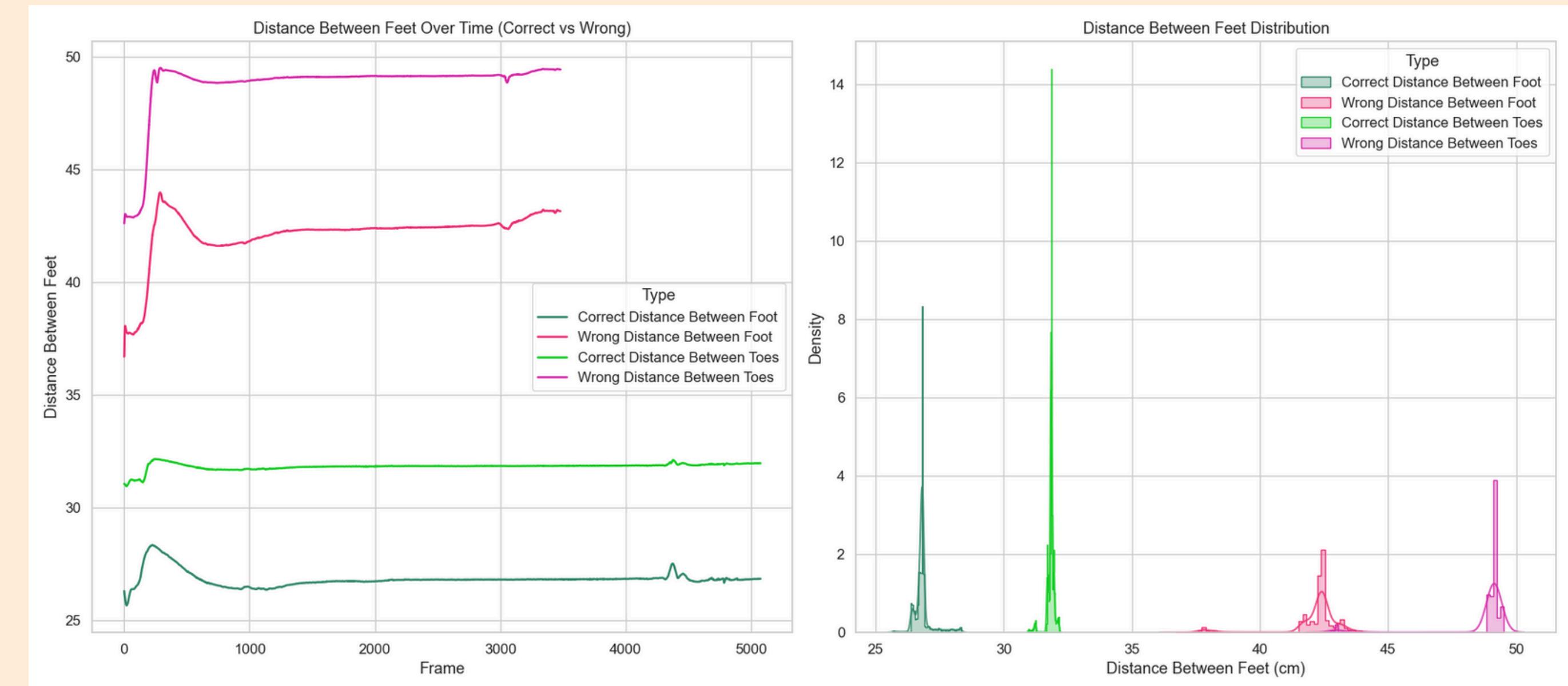
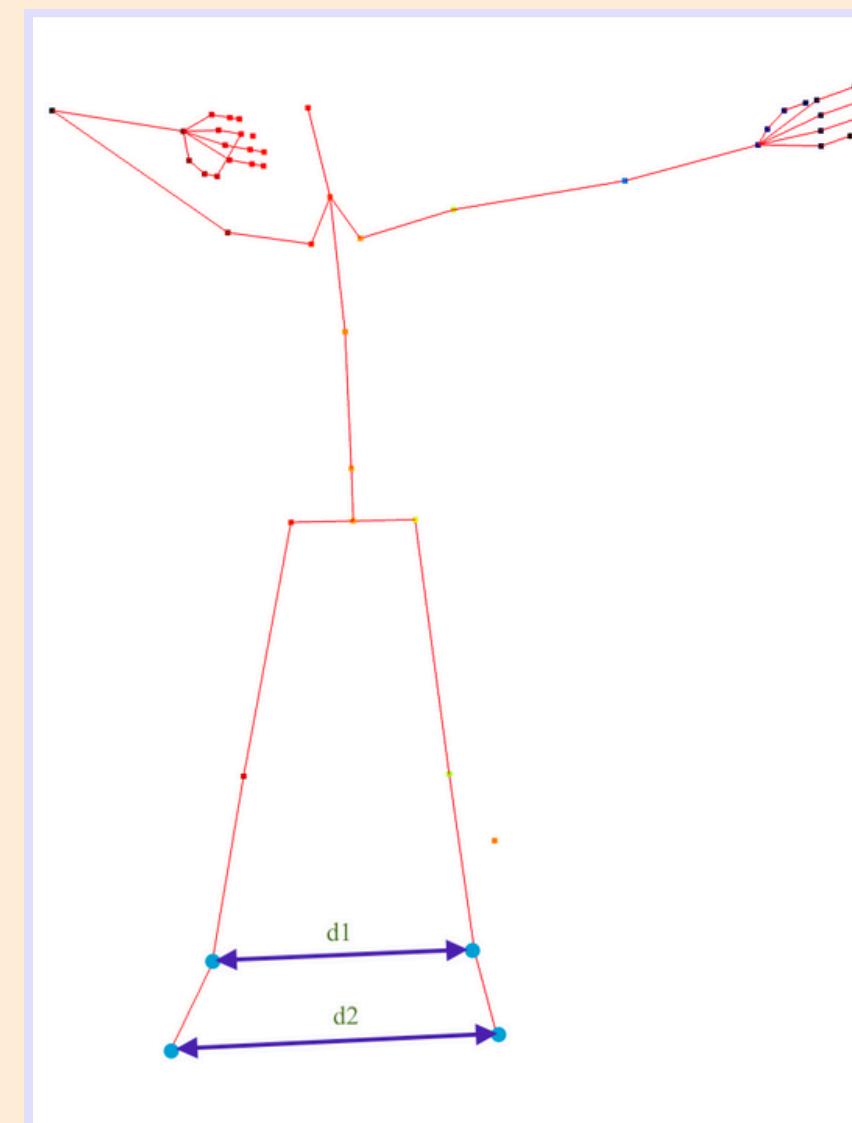
Results

Area/Metric	Correct Pos	Incorrect(left)	Incorrect(right)
Shoulder Raise	134.6°		125.6°
Feet Distance	26.83cm		42.17cm
Toe Distance	31.83cm		48.80cm
Hips Drop	$\Delta y = -1.22$	$\Delta y = 7.01$	$\Delta y = -13.1$
Back Leg Tilt	9.97°	10.54°	7.28°
Spine Tilt	8.31°	12.05°	9.16°
Hips Raise	76.16°	72.10°	69.15°

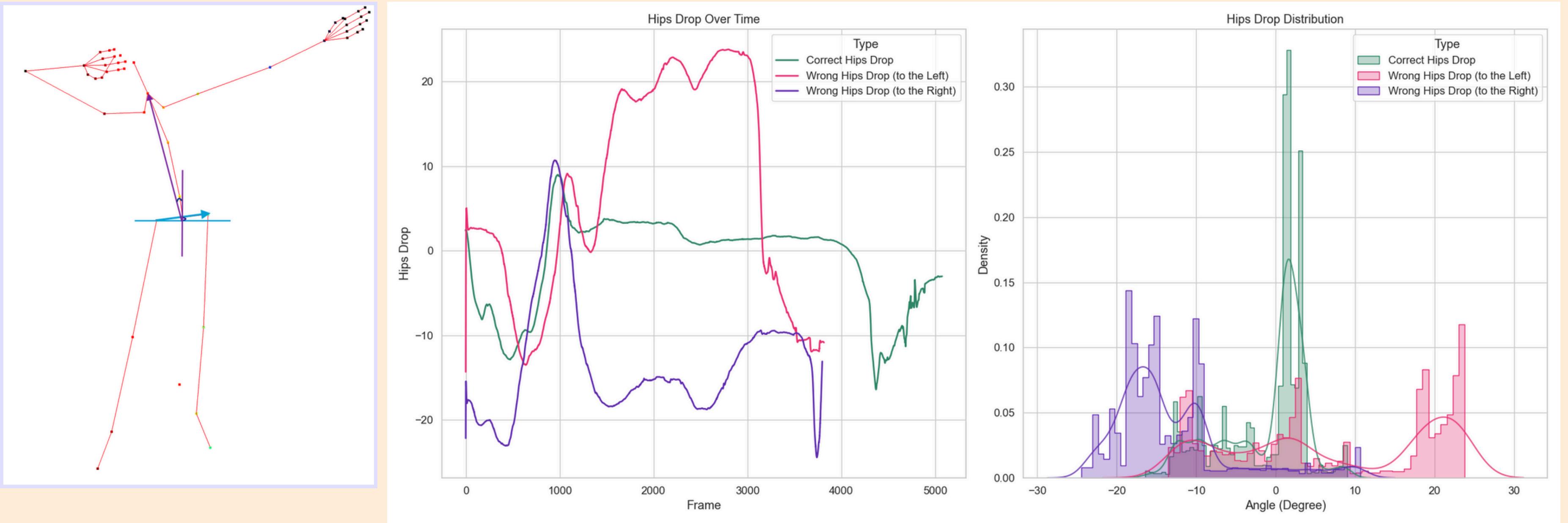
Shoulder Analysis



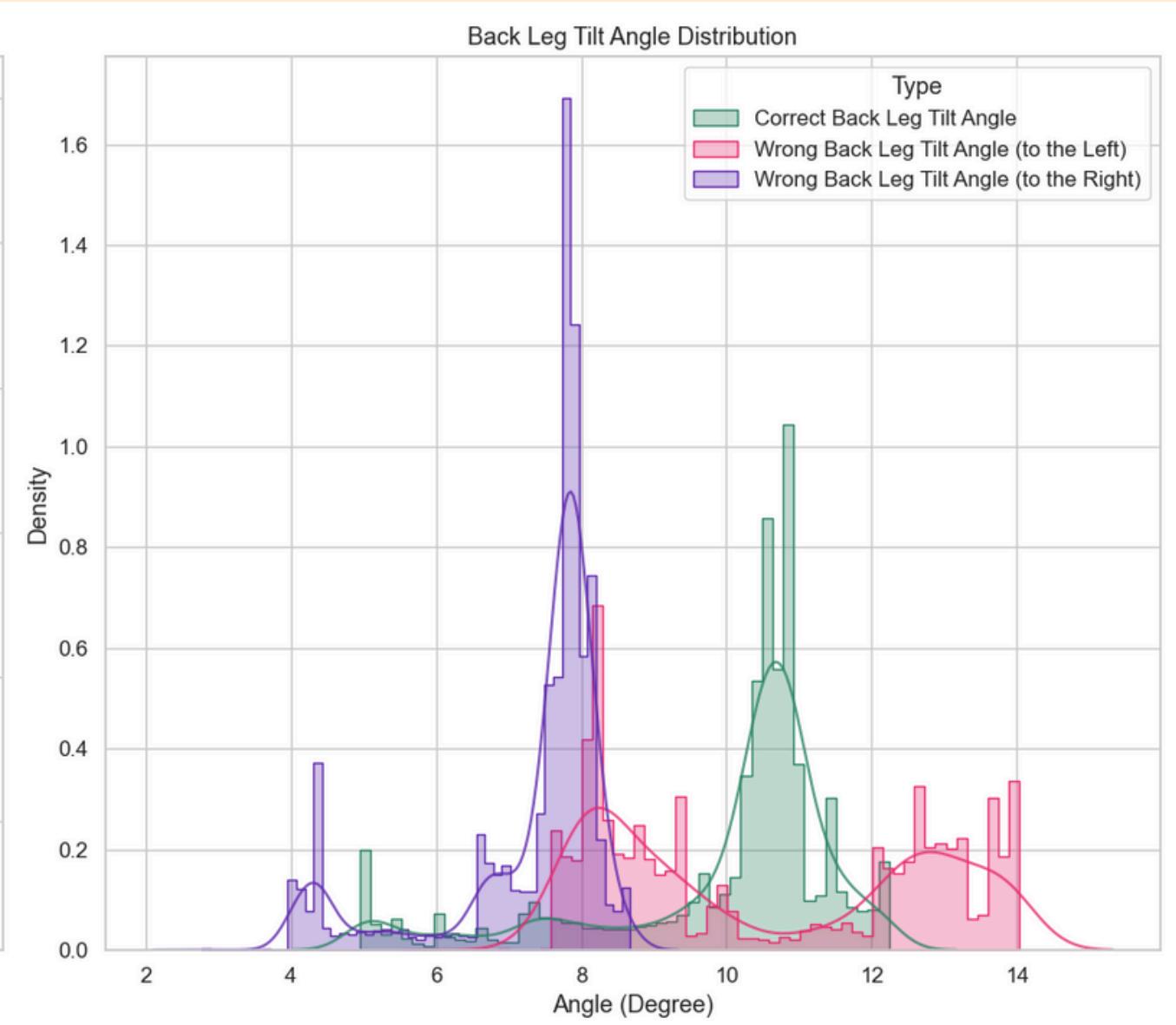
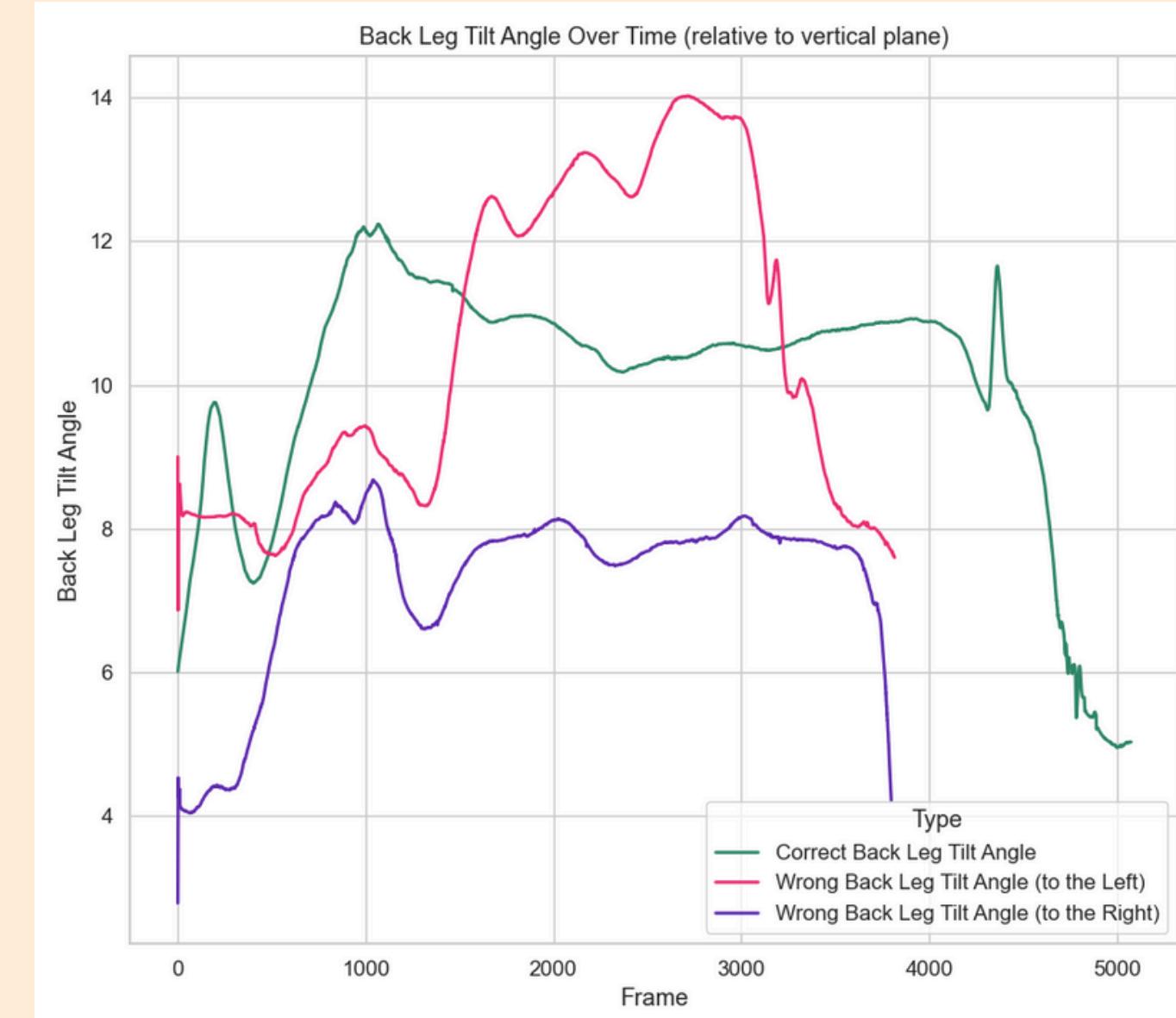
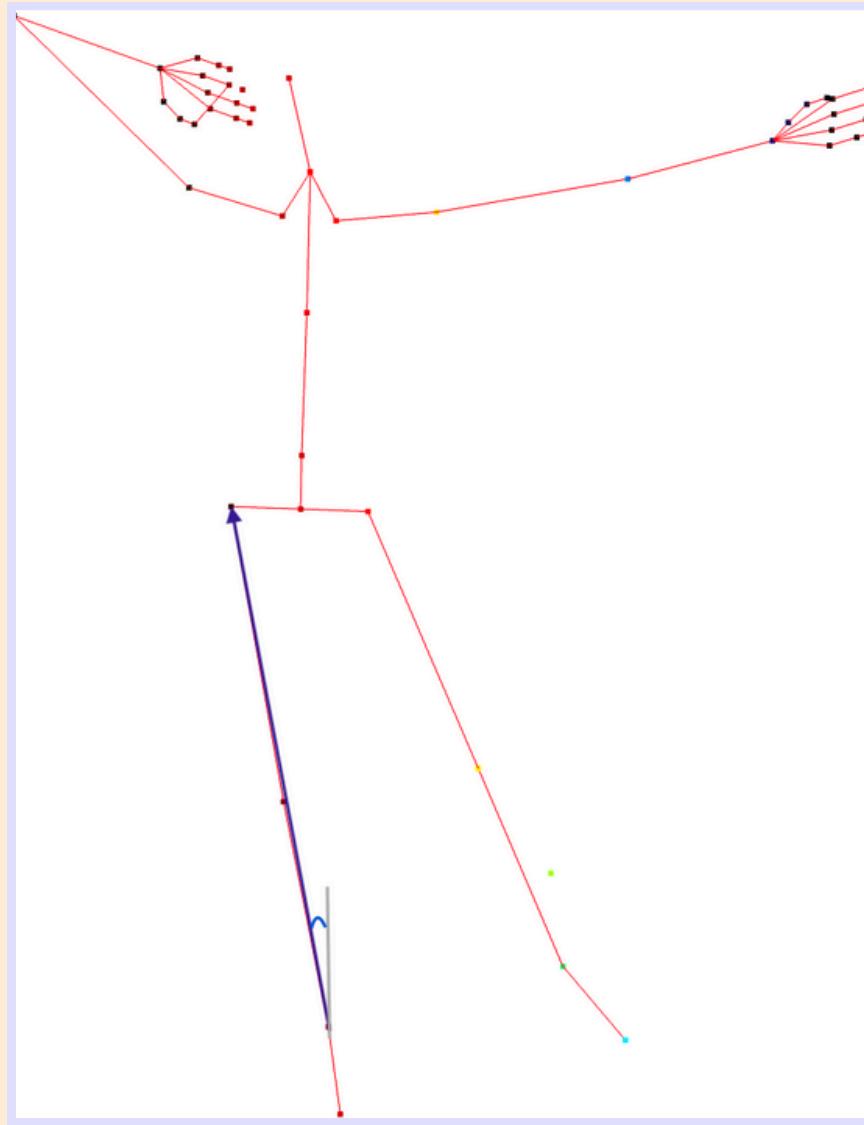
Feet Analysis



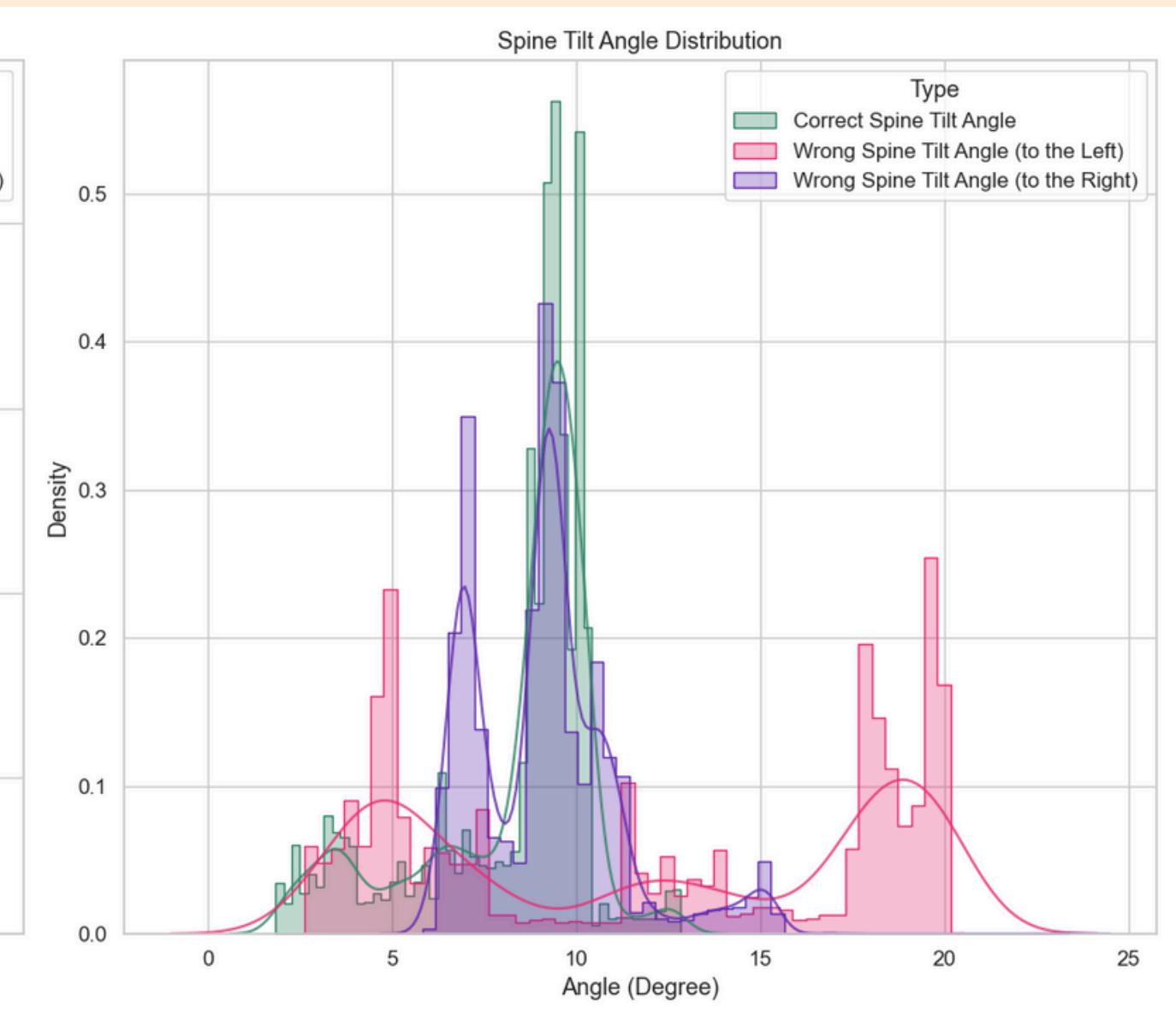
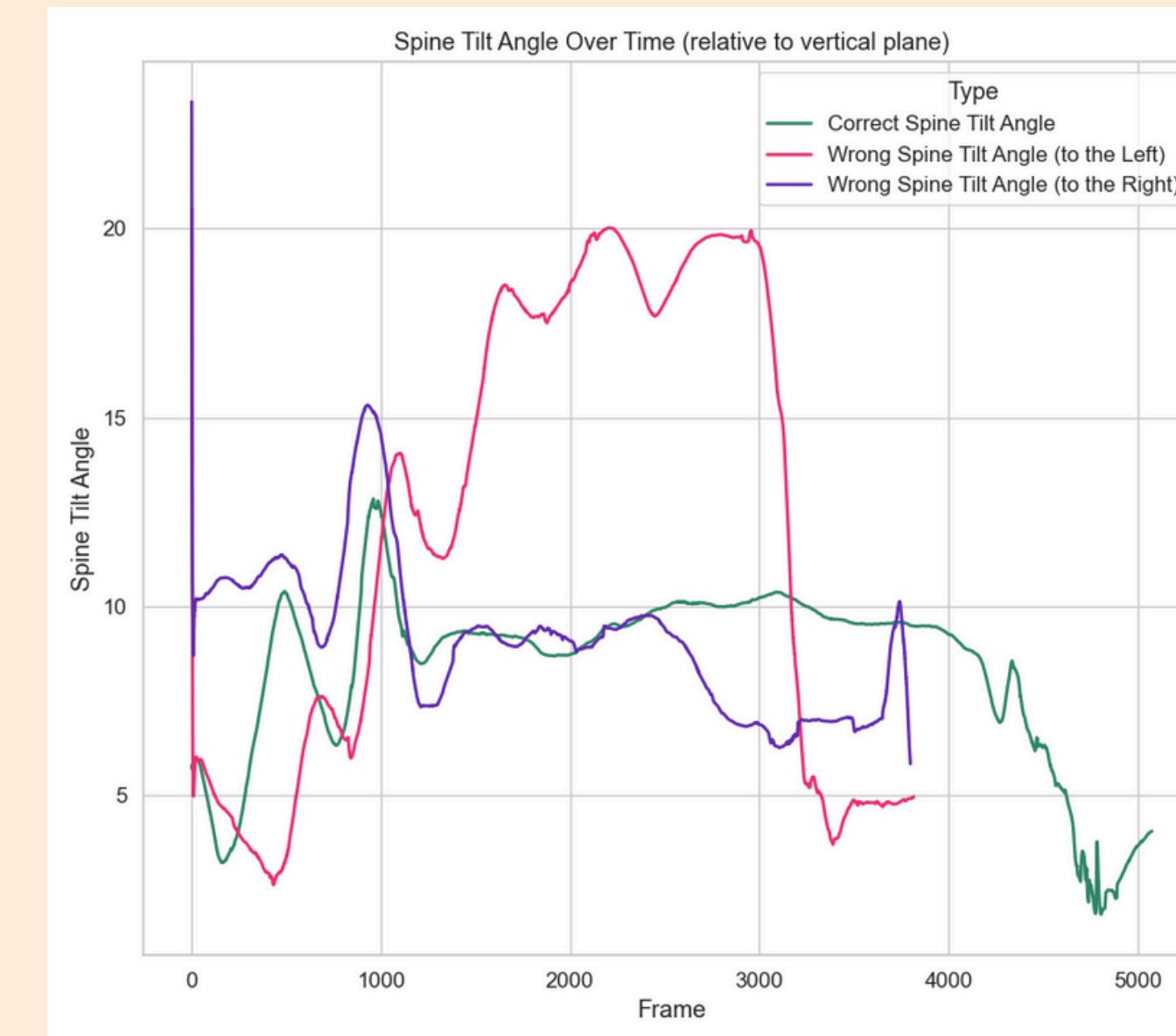
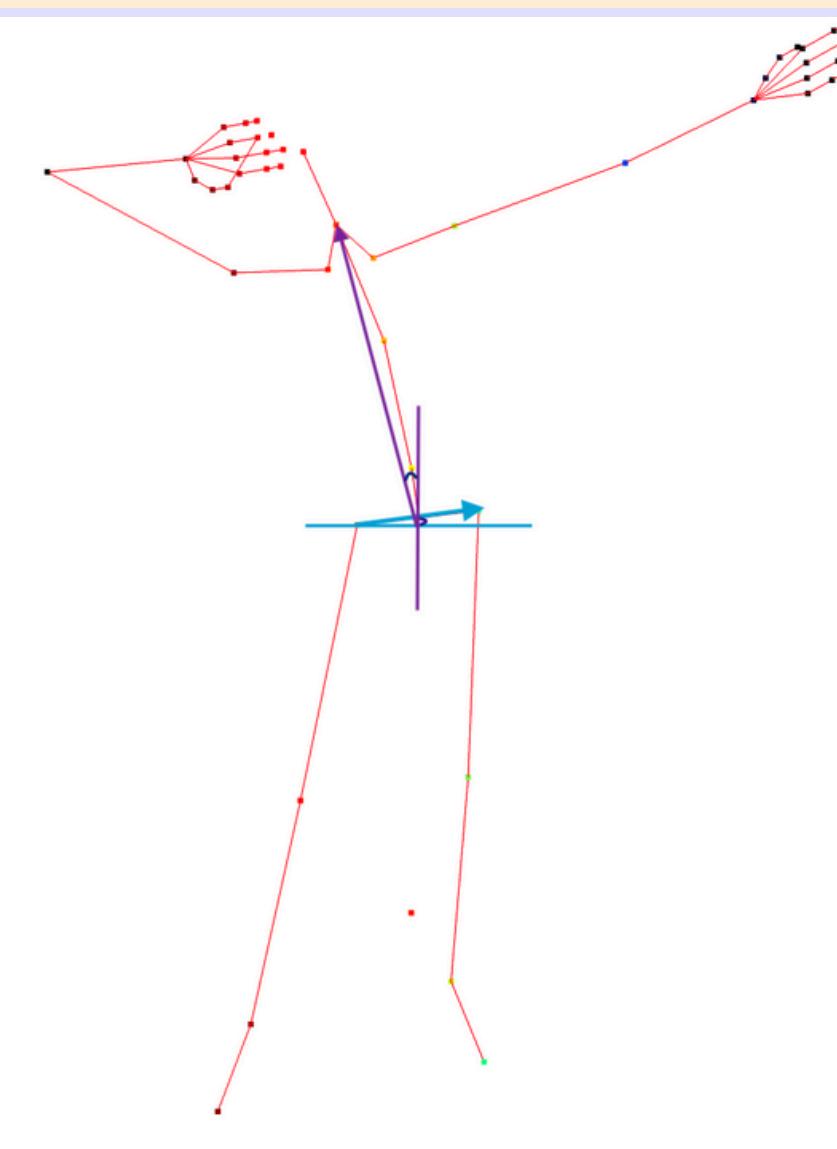
Hips Analysis



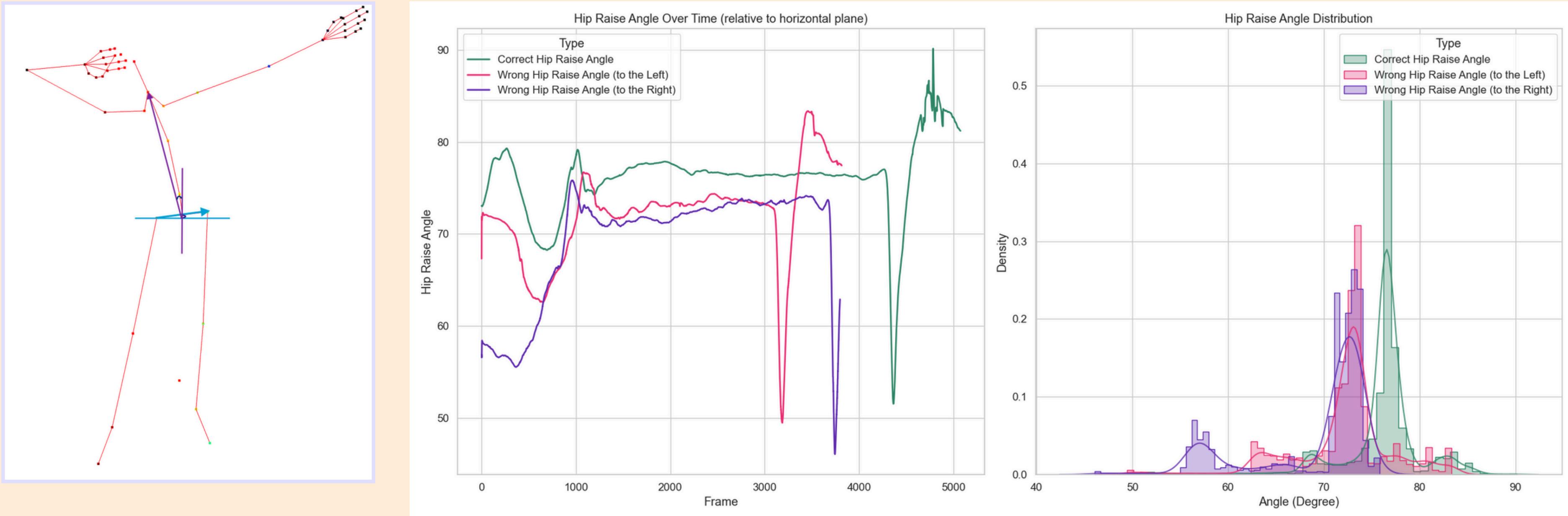
Back Leg Analysis

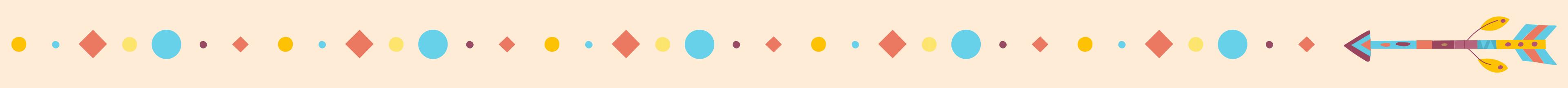


Spine Analysis

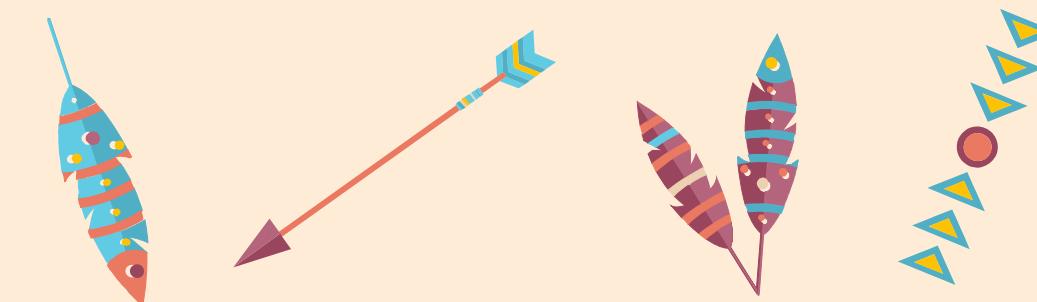


Hips Raise Analysis





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Thank
you

