# TEKFIT PRO

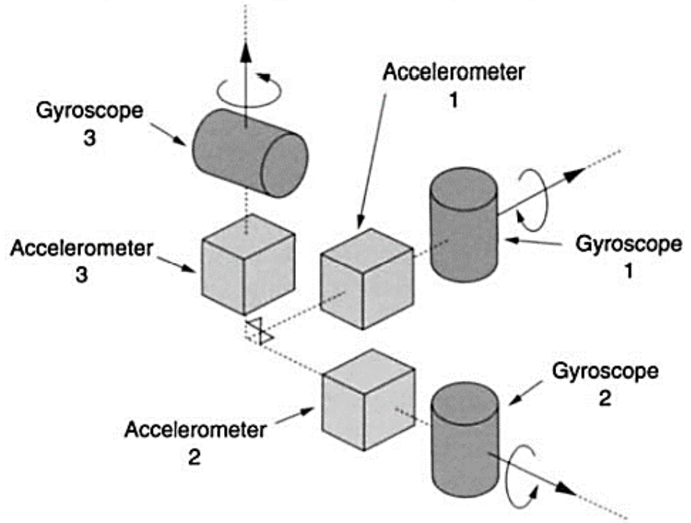
PRESENTED BY: iMOTEK

# Catalogue

- Basic information
  - IMU sensor
  - Bike Fitting
- TEKFIT Pro system software
- Report
  - Stability result
  - Motion result

# Inertial Measurement Unit (IMU)

- Composed of an accelerometer, gyroscope, and magnetometer.
- Commonly used to measure speed, rotation angle, gravity, and magnetic force.
- IMU are commonly used to control aircraft, including unmanned aerial vehicles (UAV), as well as spacecraft,




6DOF IMU

DARE Rocket

PAL Robotics

**Image Source:**

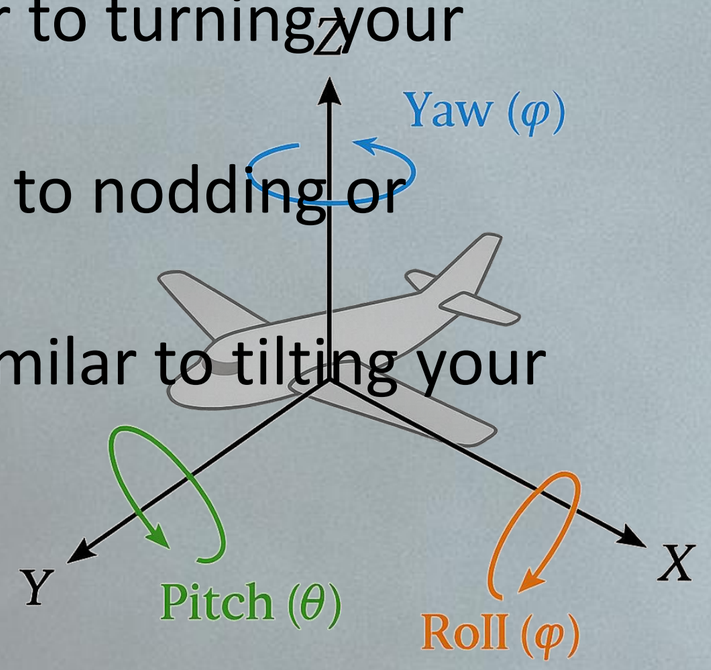
(Barbour, 2001)
(Dissanayake et al, 2001)
(Saripalli et al, 2003)

# Inertial Measurement Unit (IMU)

## Euler angles

- Euler angles are a method for describing an object's orientation in three-dimensional space using three angles: Yaw (ψ), Pitch (θ), and Roll (ϕ).

- **Yaw(ψ)**: rotation around the vertical axis (Z-axis), similar to turning your head left or right.
- **Pitch(θ)**: rotation around the lateral axis (Y-axis), similar to nodding or tilting your head up and down.
- **Roll(ϕ)**: rotation around the longitudinal axis (X-axis), similar to tilting your head side to side.



# Inertial Measurement Unit (IMU)

## IMU Data Processing Flow

**Raw Data**

- Tri-axial Accelerometer
- Tri-axial Gyroscope
- Tri-axial Magnetometer

**Sensor Fusion & Attitude and Heading Reference System (AHRS)**

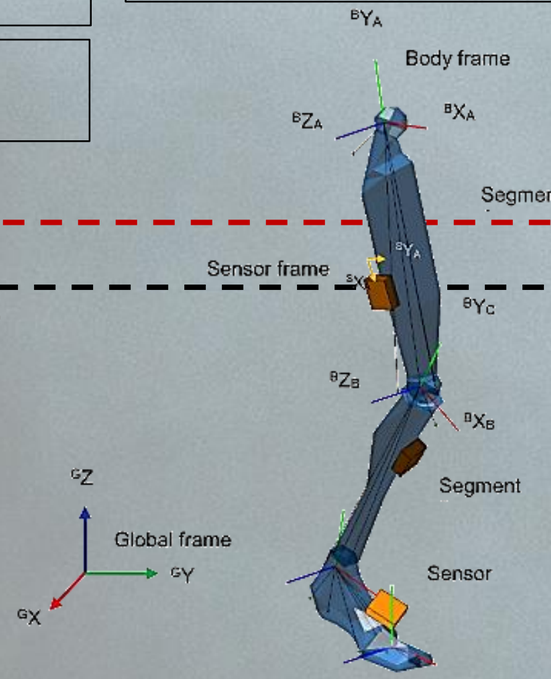
- Final Orientation & Euler Angles
- Non-volatile Calibration & Performance Settings
- Normalization, Error Compensation & Kalman Filtering

**Modeling**

- Bone Landmarks
- Body Segments
- Joint Center

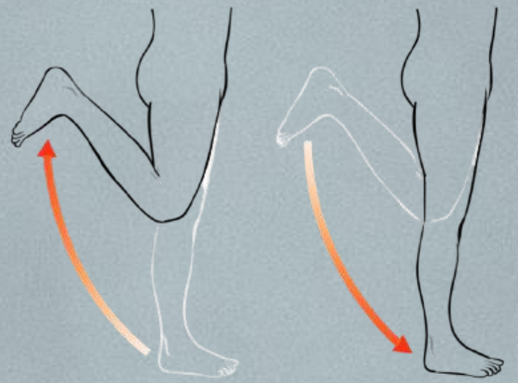
**Kinematics & Kinetics**

- Joint Angle
- Joint Force

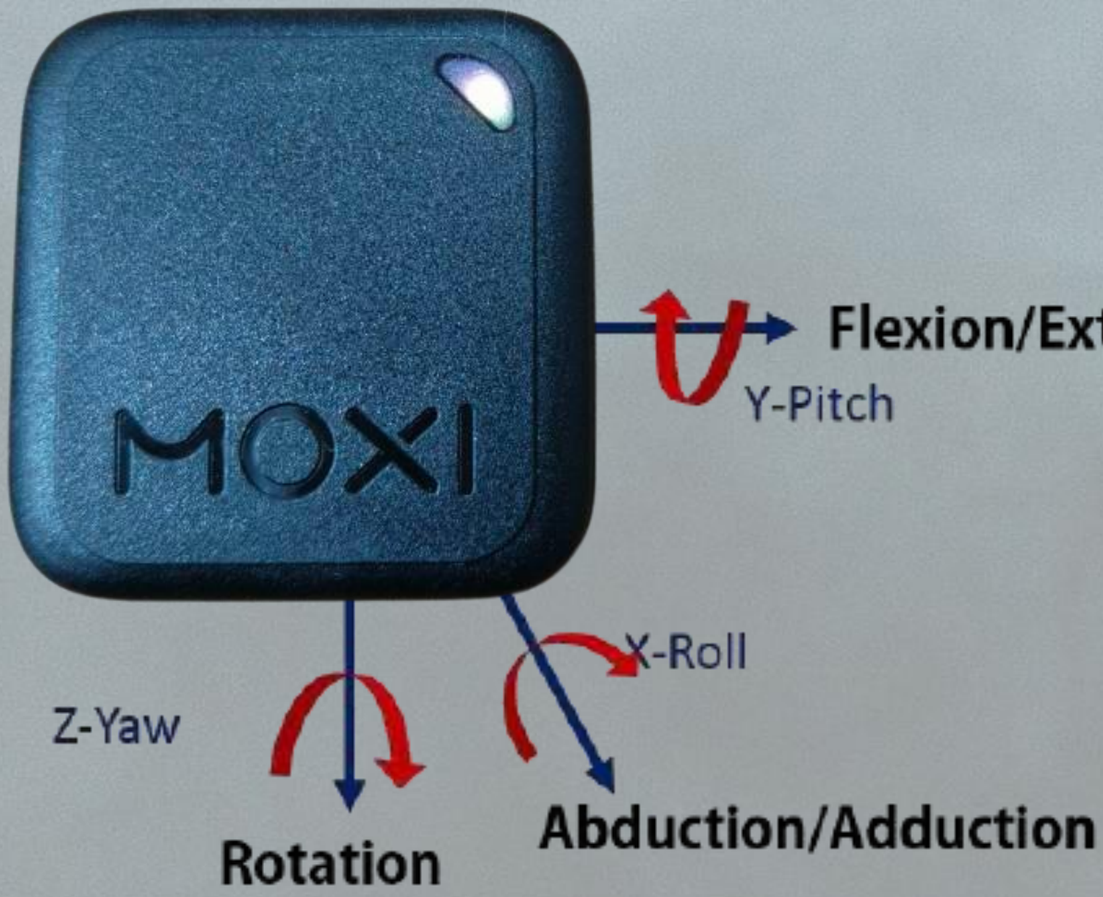


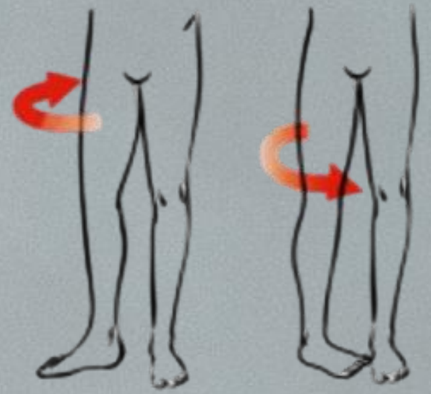

AHRS:Attitude and heading reference system

# Inertial Measurement Unit (IMU)



Flextion Extention



Lateral rotation Medial rotation

Abduction Adduction

# Inertial Measurement Unit (IMU)

## Accuracy

- RMSD < 2°: High precision — within the natural range of individual kinematic variation

We're HERE!!!

- 2° < RMSD ≤ 5°: Acceptable precision
- 5° < RMSD ≤ 10°: Tolerable precision — should be taken into account when interpreting results
- RMSD > 10°: Unacceptable precision

(McGinley JL, 2009)

# Bike Fitting

## Static Fitting

- Frame Size
- Saddle Height Setting
- Crank Arm Length
- Stem Length

## Dynamic Fitting

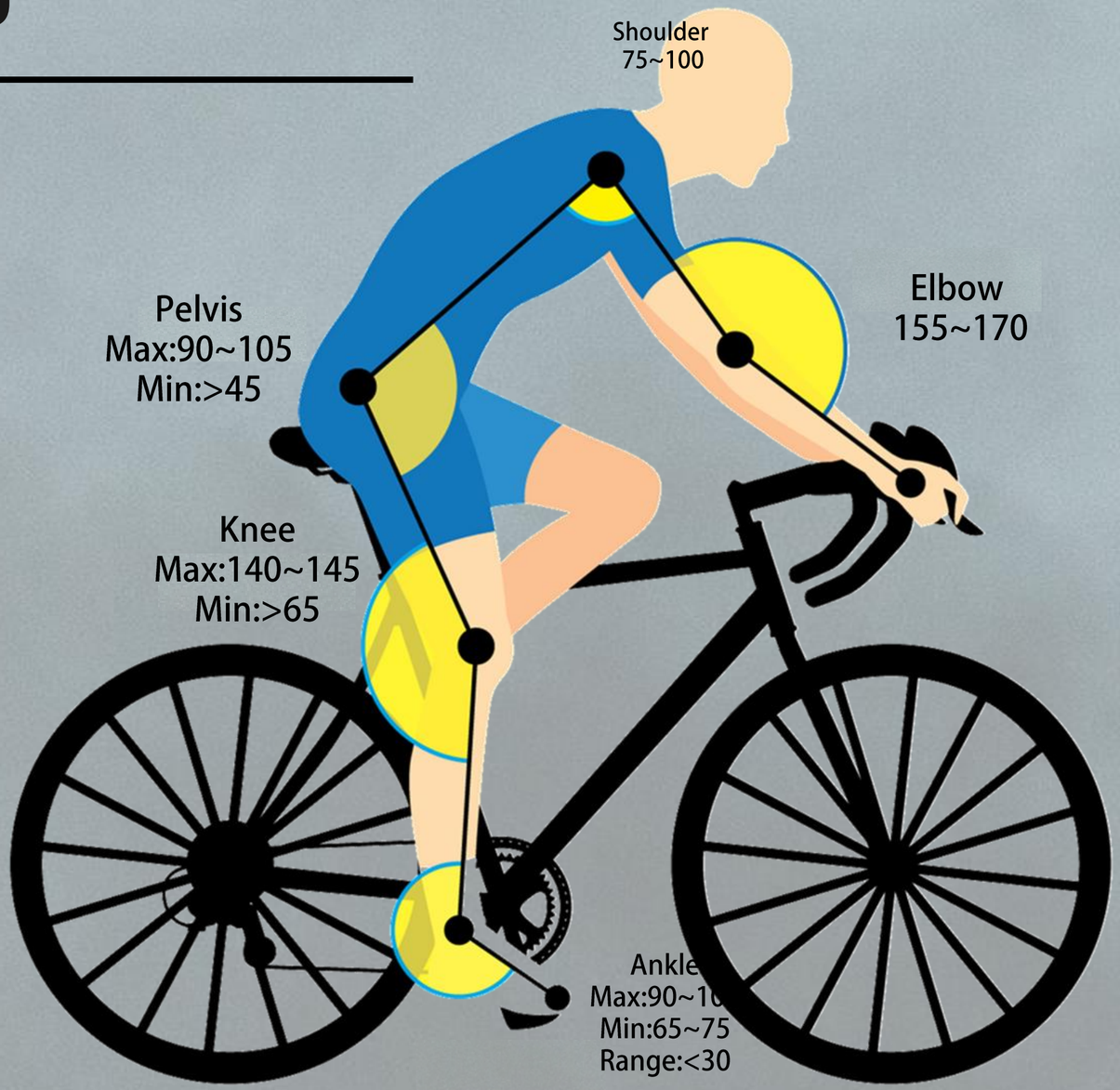
- Riding Posture Correction
- Riding Motion Training
- Dynamic Riding Trajectory
- Riding Posture Angle

## Pedaling Analyzer

- Pedaling Training
- Riding Performance Analysis
- Pedal Center Offset

The source of picture: www.bikefitting.com

# Static Fitting



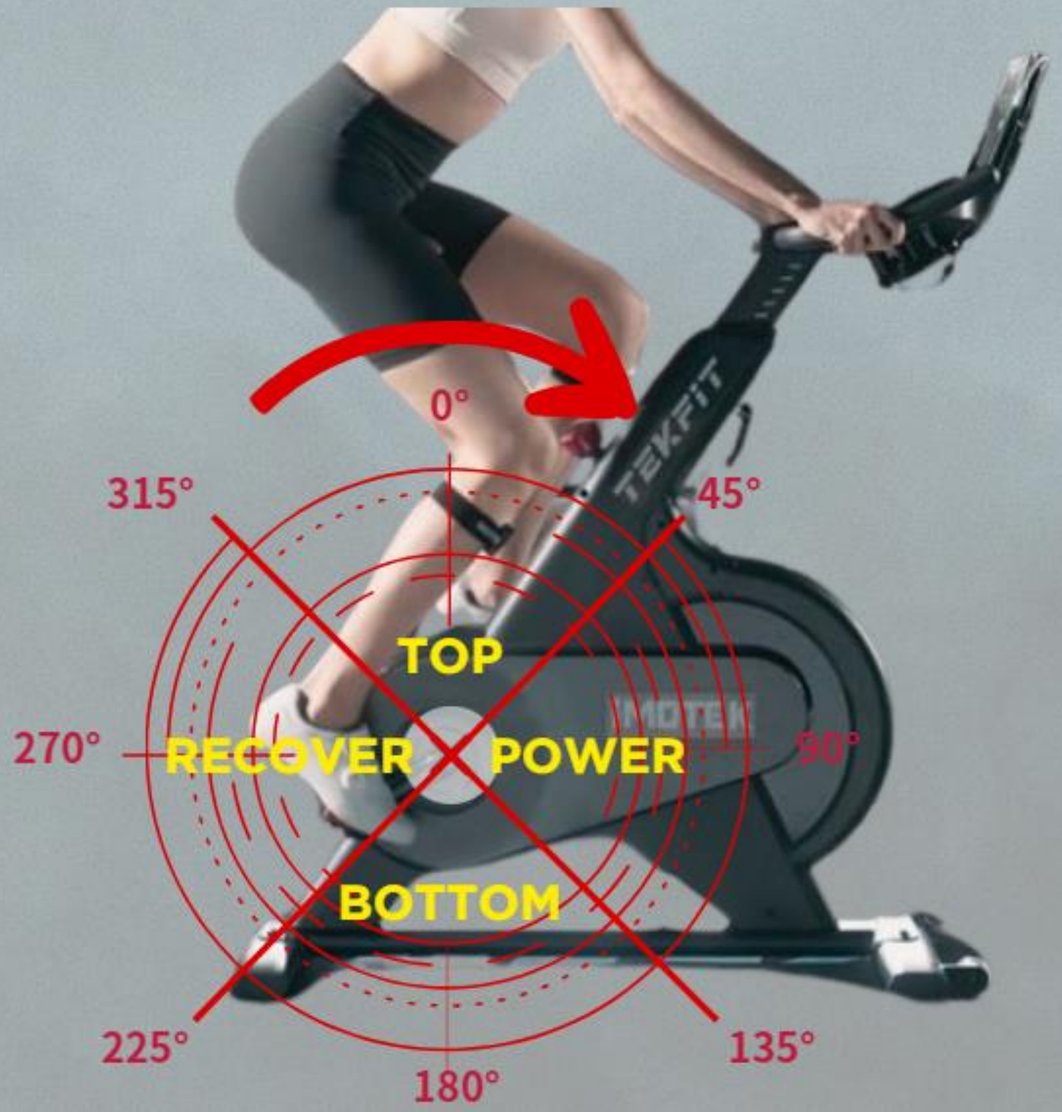
# Dynamic Fitting

**Valgus**
**Varus**

**Straight**
**Straight**

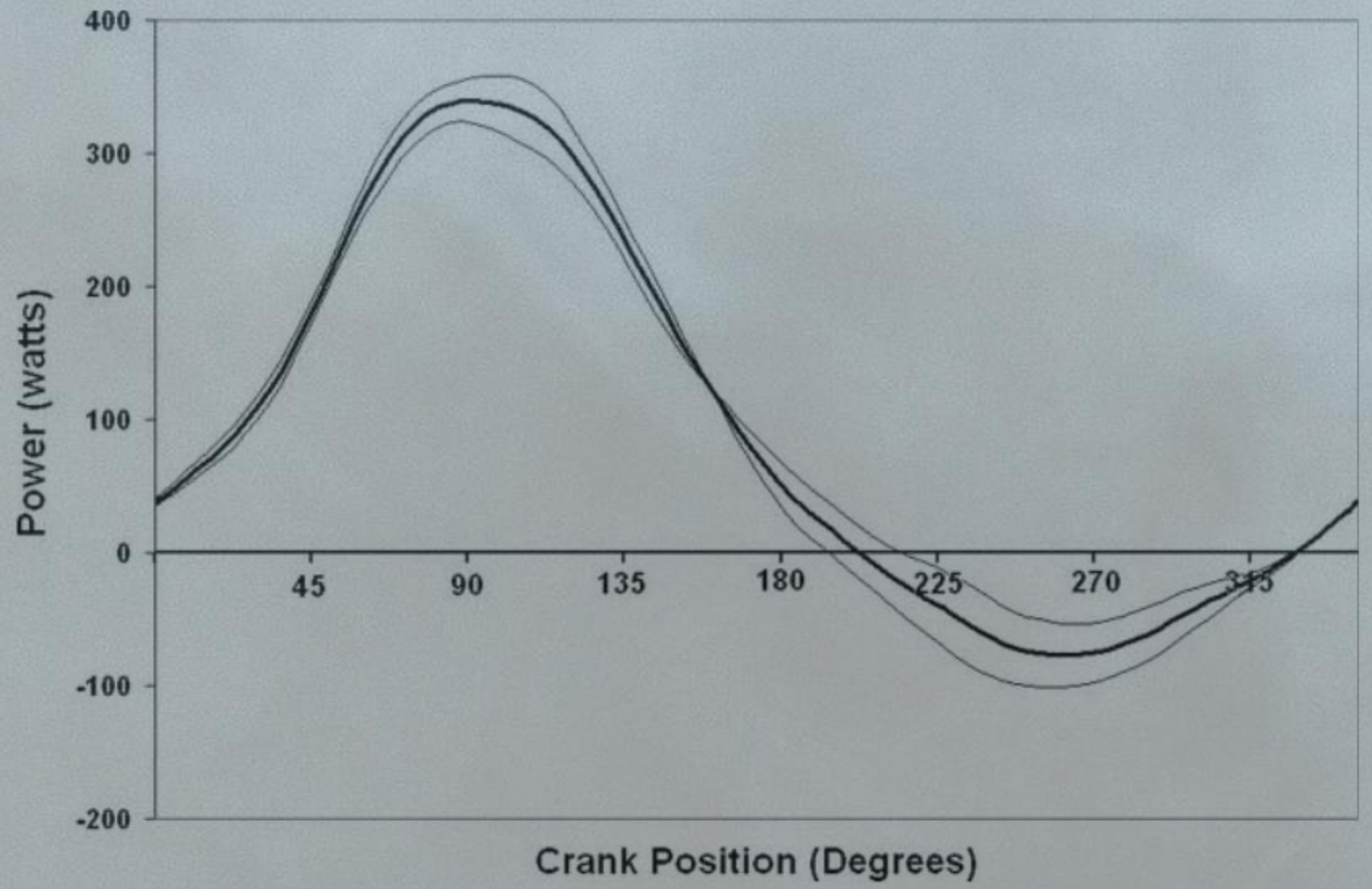
**Varus**
**Valgus**

# Phase of Cycling



# -Phase of Cycling





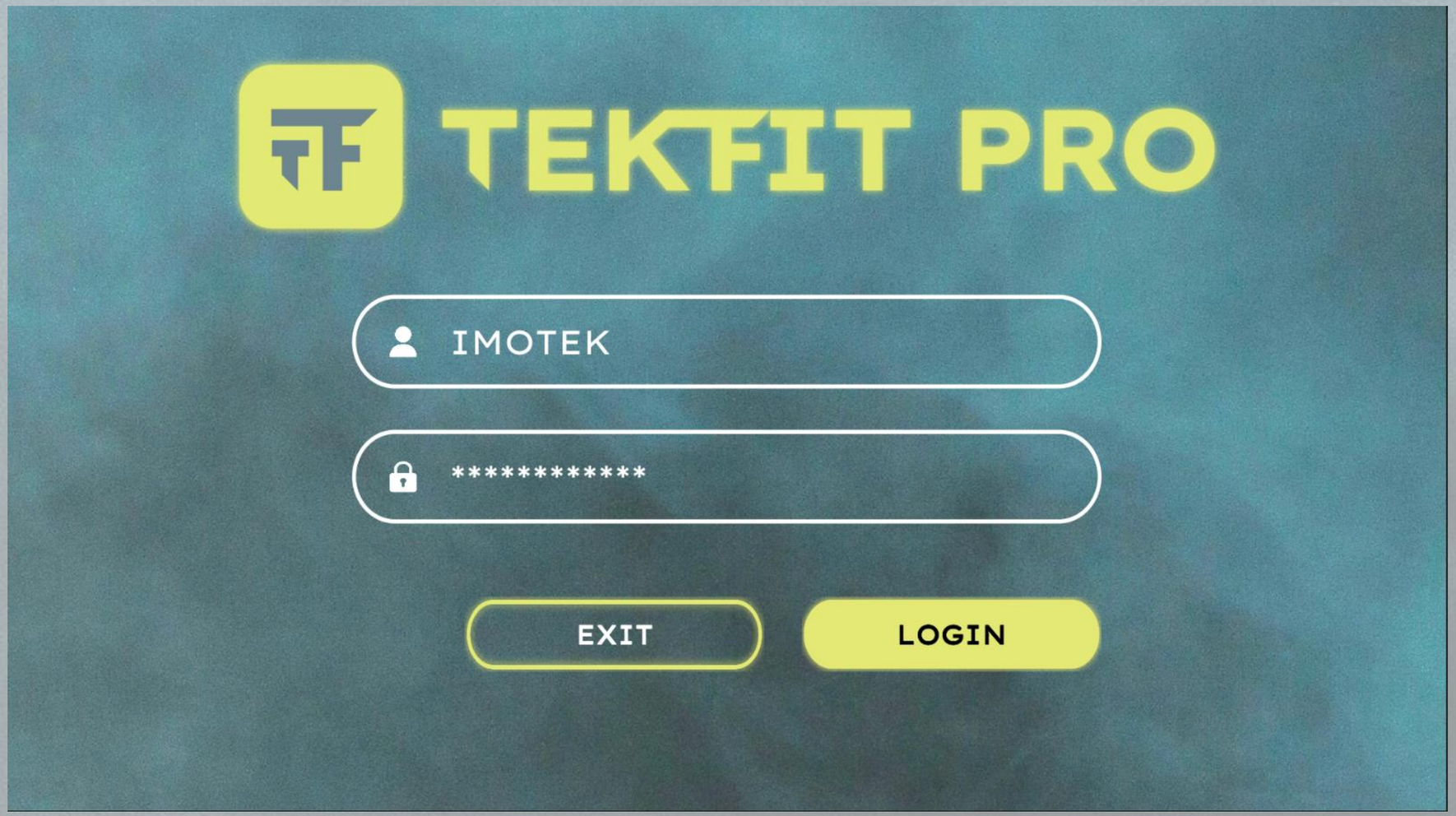
# User Guide - TEKFIT Pro


## Download

→ Step1:Google Play Store
Search:TEKFIT PRO

→ Step2: Install

# User Guide - TEKFIT Pro




## Log In

→ Step1: Enter:Account\Passwor

→ Step2: Tap LOGIN

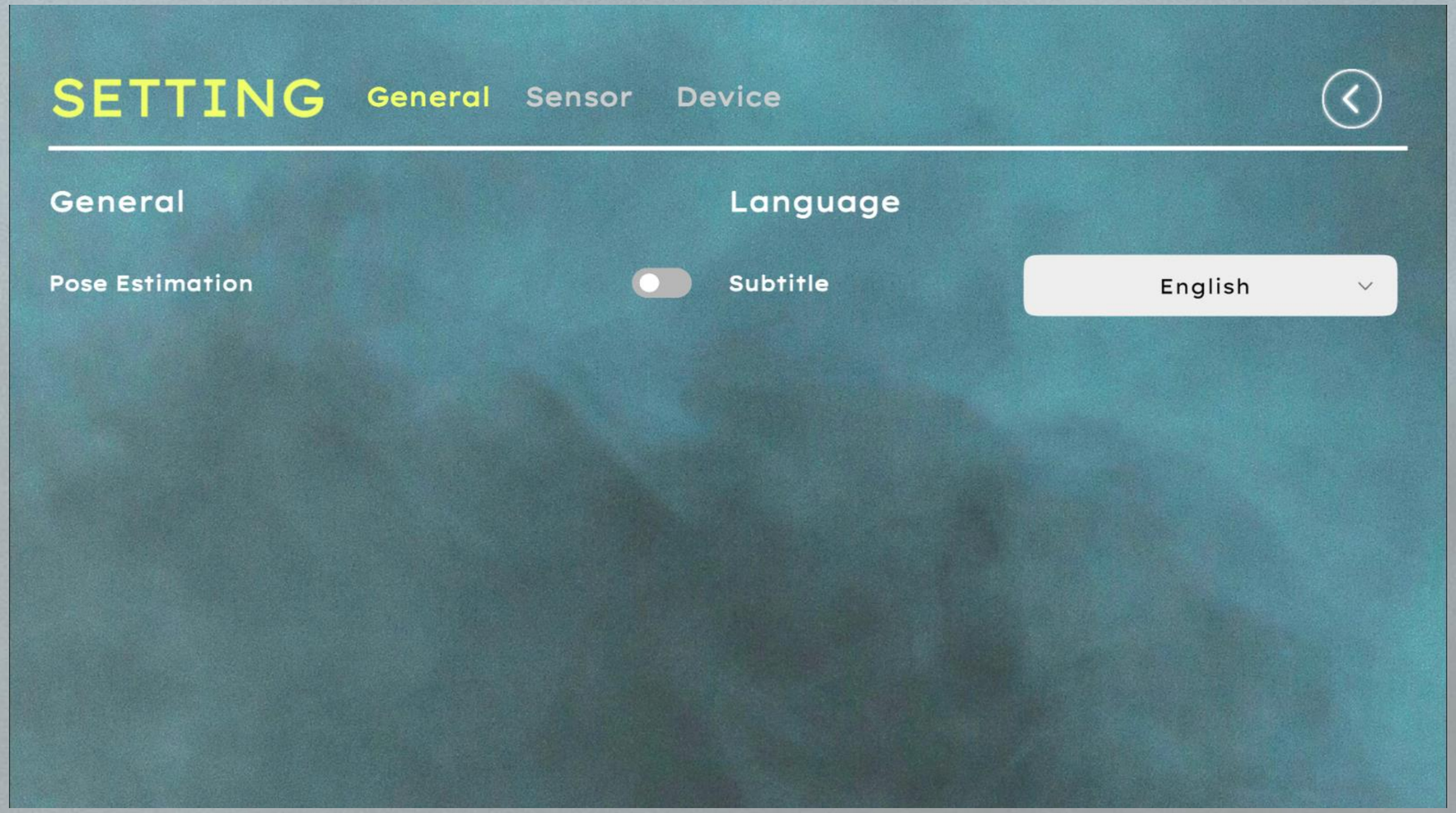
→ Step3: Enter License Key

# User Guide - TEKFIT Pro


## Settings

→ Step1: Tap the g icon

# User Guide - TEKFIT Pro

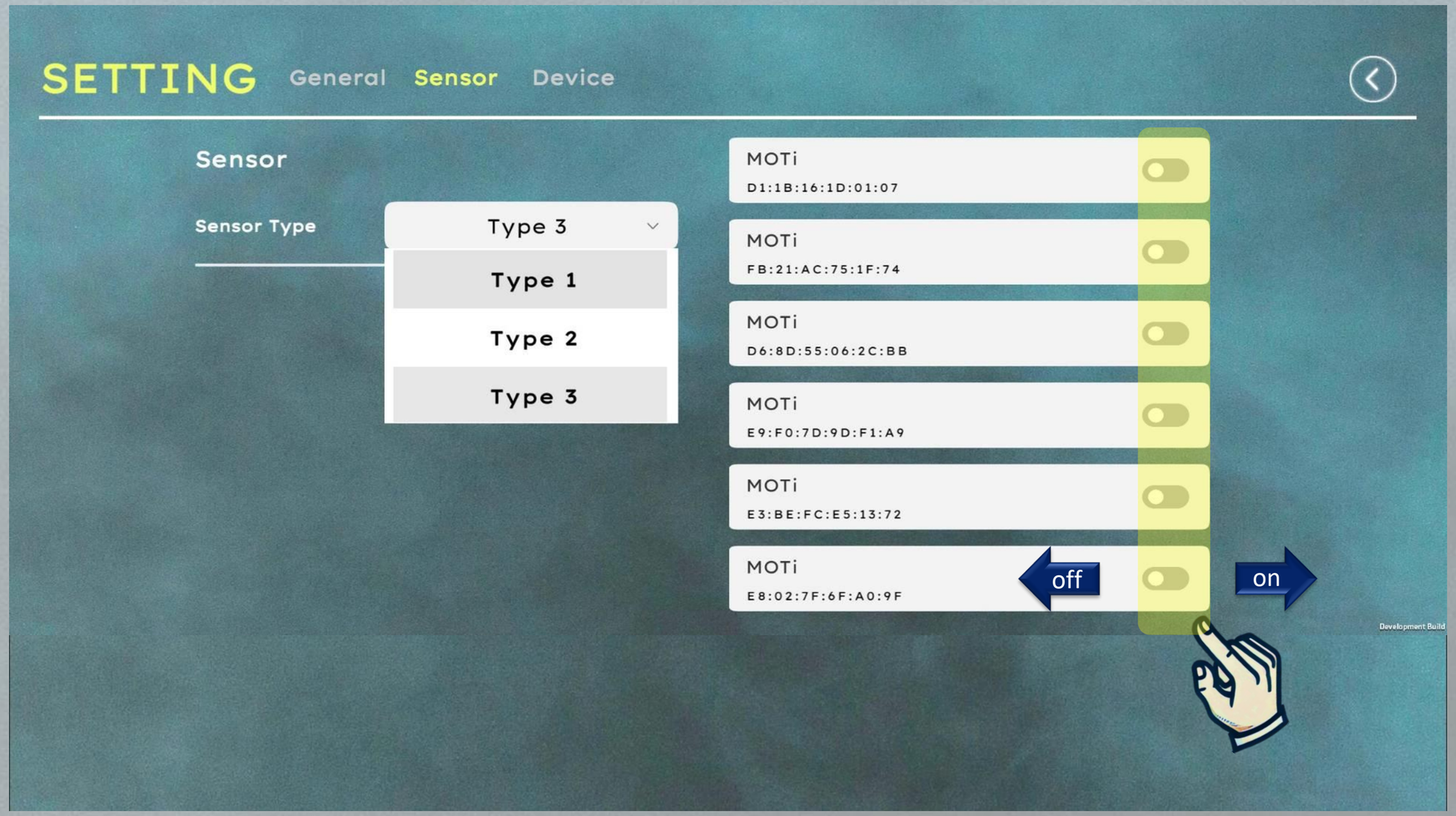



## Settings — General

→ Step1: Select language

→ Step2: Pose Recognition (Real-time automatic recognition of human skeletal segments, used by BIKE Fitting. Can be freely turned on or off — enabling it consumes more CPU/GPU performance.)

# User Guide - TEKFIT Pro

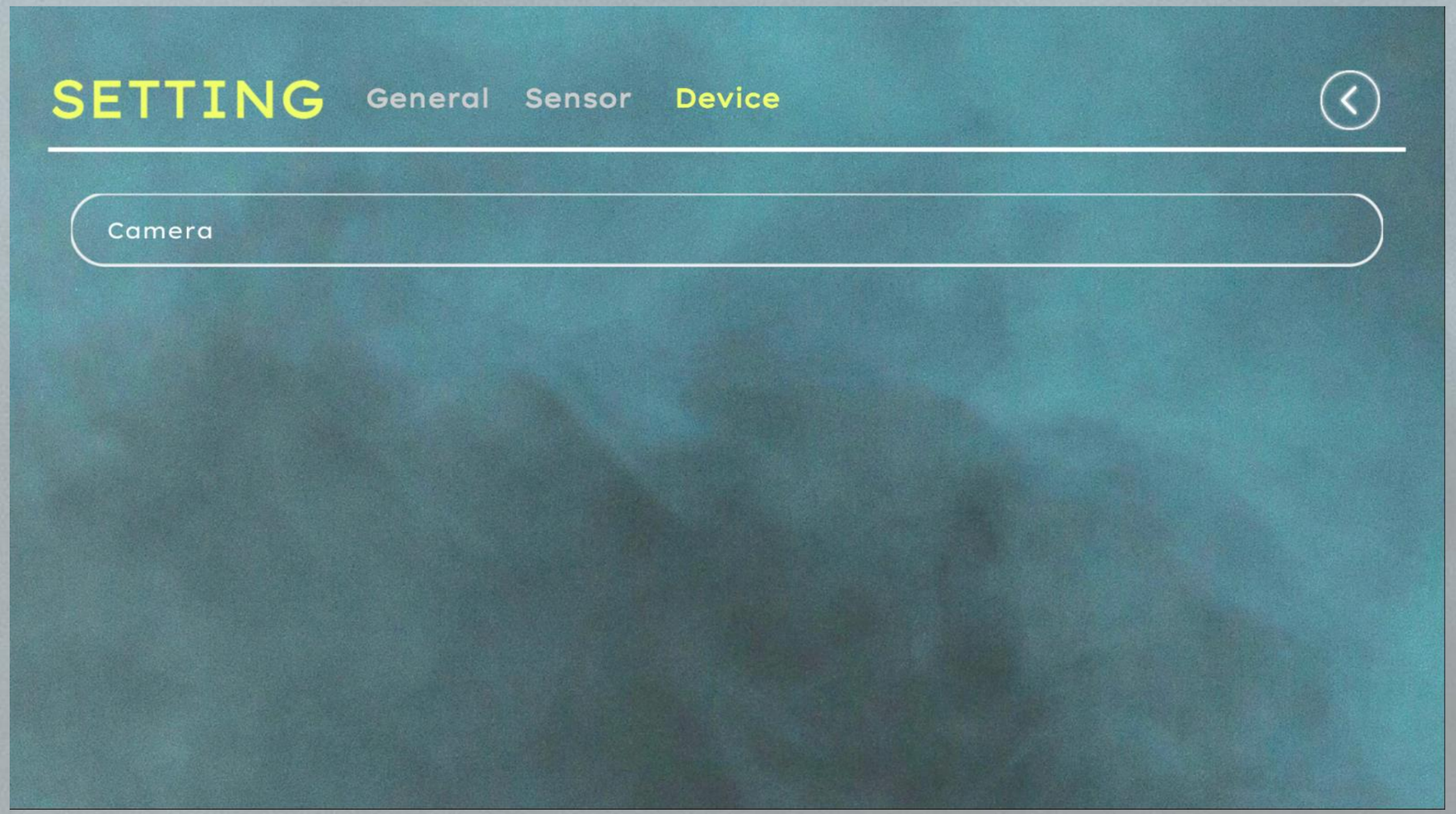



## Settings — Sensor

→ Step1: Select Sensor Type
  Type1:ALDA
  Type1:Movella Dot
  Type3:MOTi

→ Step2: Connect (ON) sensor

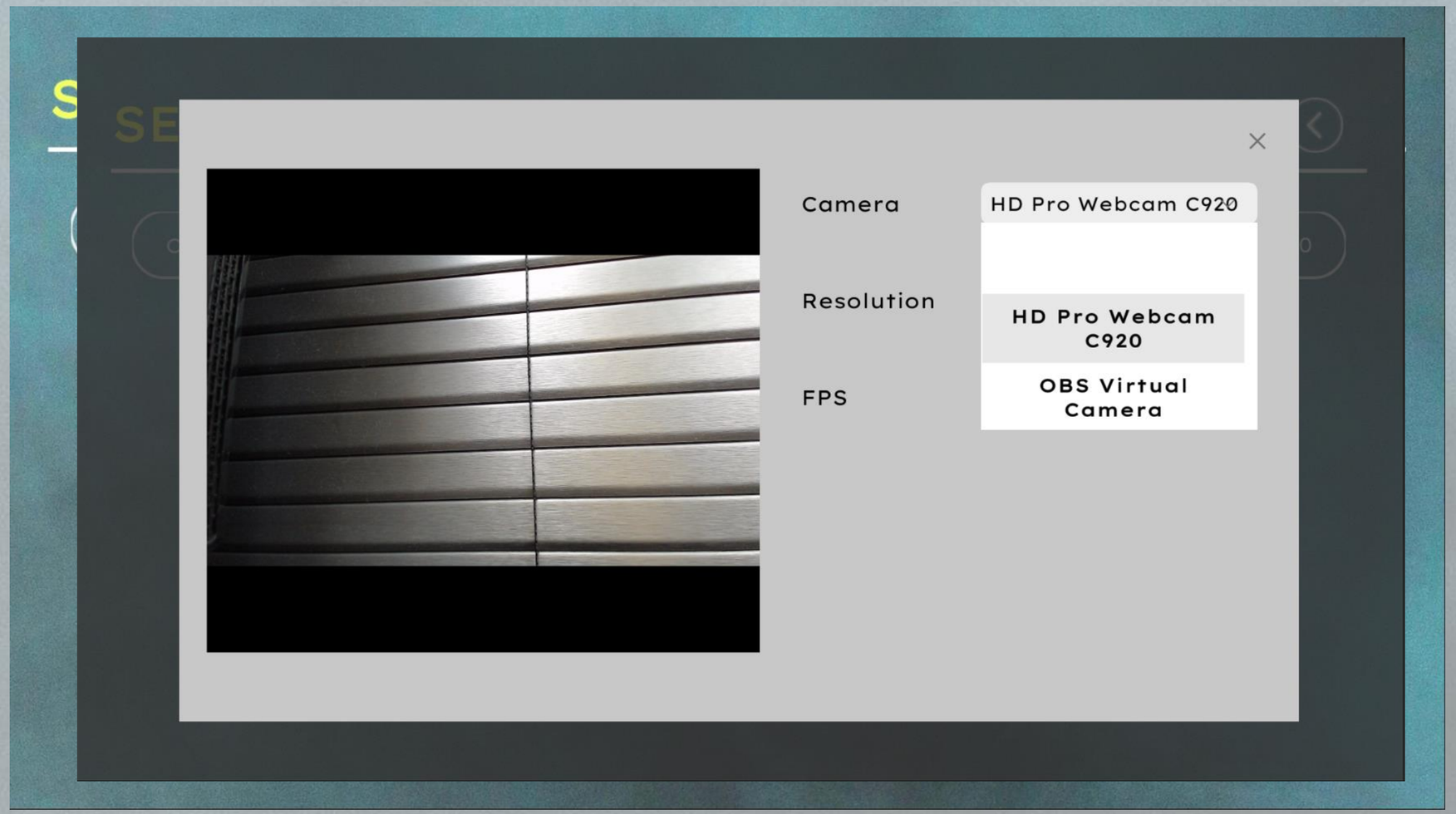
# User Guide - TEKFIT Pro




## Settings — Device

→ Step1: Tap Camera configuration

# User Guide - TEKFIT Pro

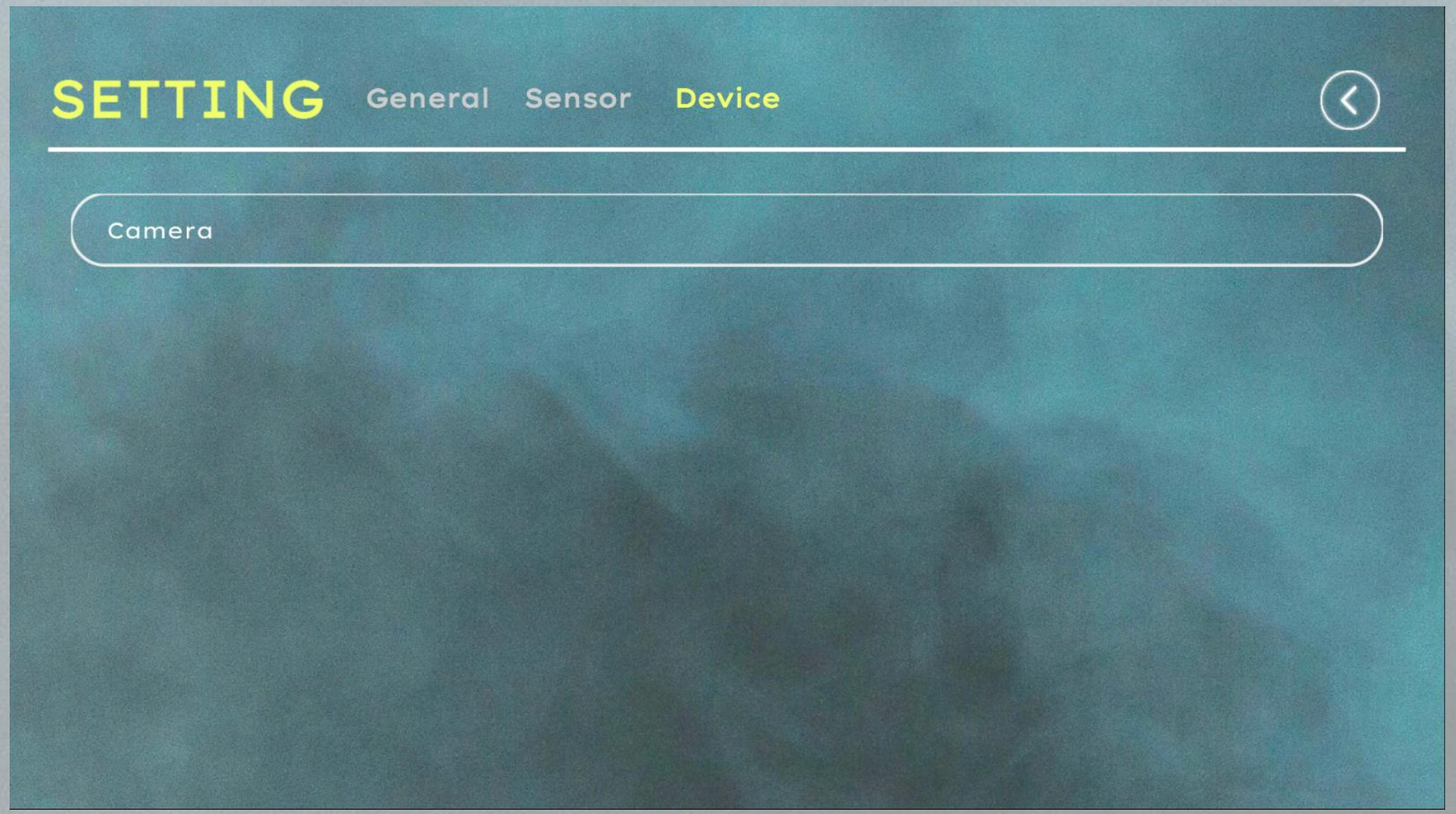



## Settings — Device

→ Step1: Select camera lens

(If the lens is detected successfully, a live image appears on the left. If not, close and reopen the app, and confirm that Android has granted TEKFIT Pro permission to access the camera)

# User Guide - TEKFIT Pro




Setup Complete — Return to Main Screen

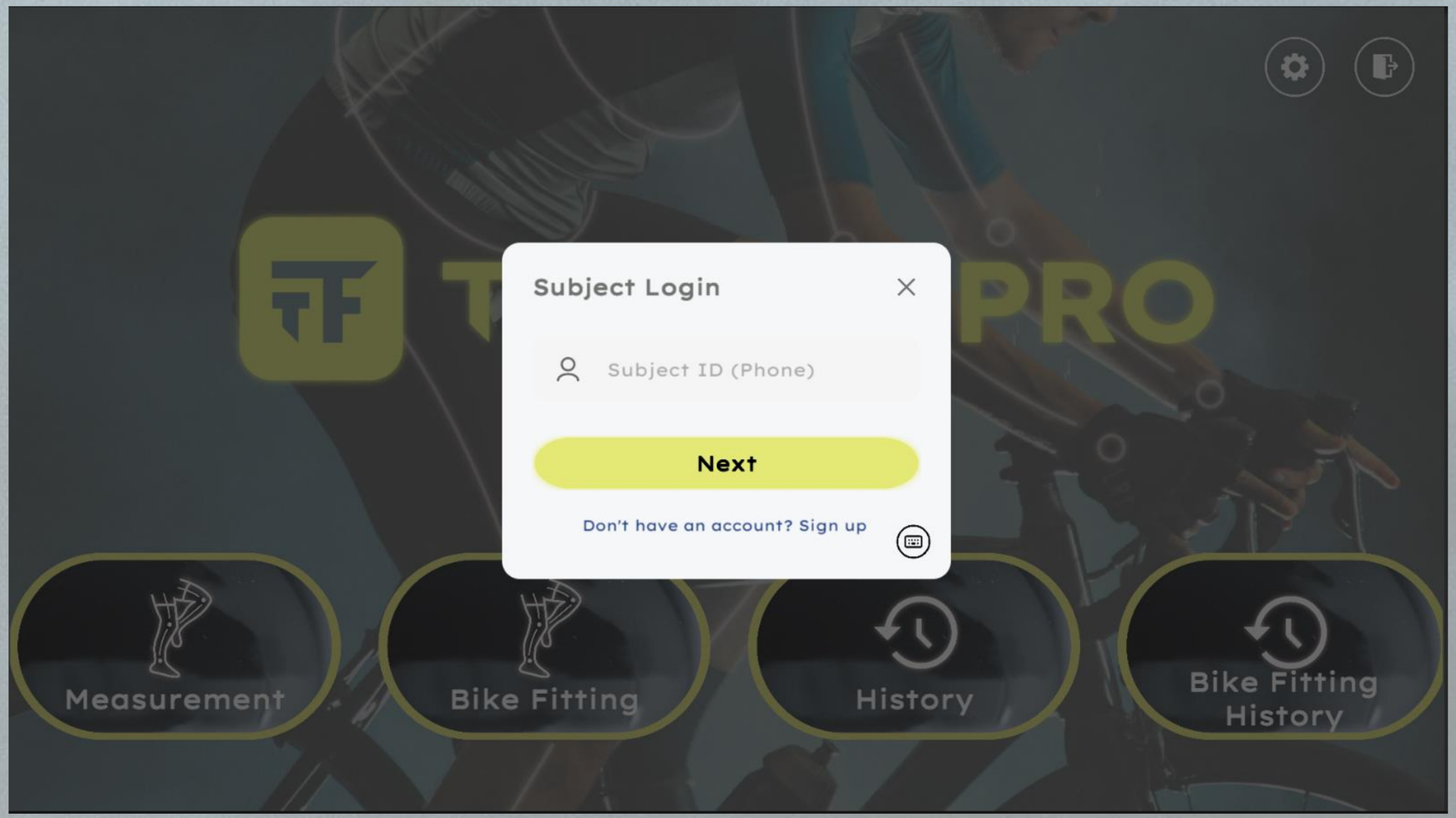
→ Step1: Tap

# User Guide - TEKFIT Pro


## Measurement

→ Step1: Tap Measurement (Knee and pelvis motion performance measurement)

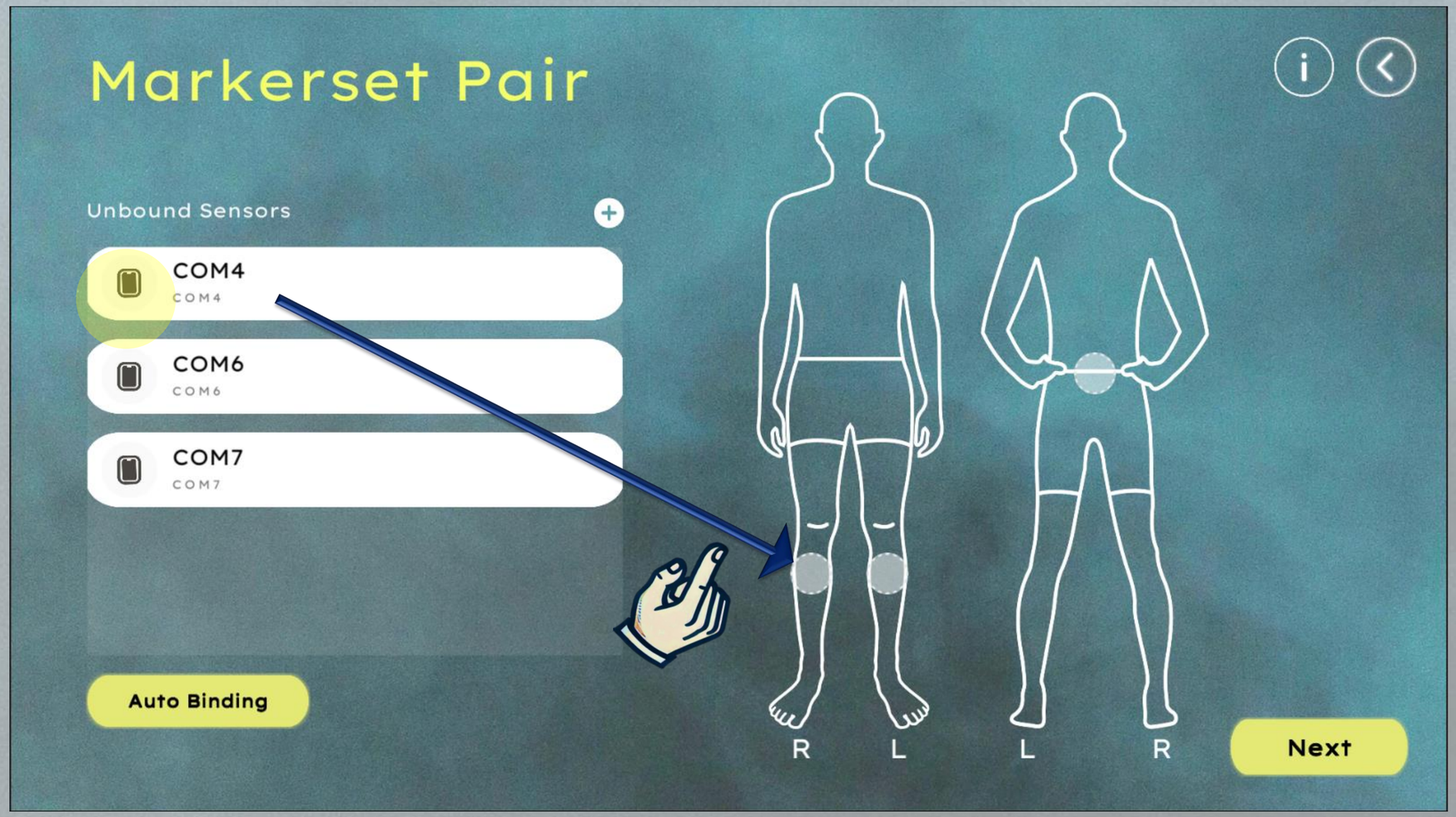
# User Guide - TEKFIT Pro




## Subject Login (Client)

→ Step1: Enter phone number
(For first-time use, tap Sign up in the bottom right — a phone number is required)

# User Guide - TEKFIT Pro




## Sensor Placement Setup

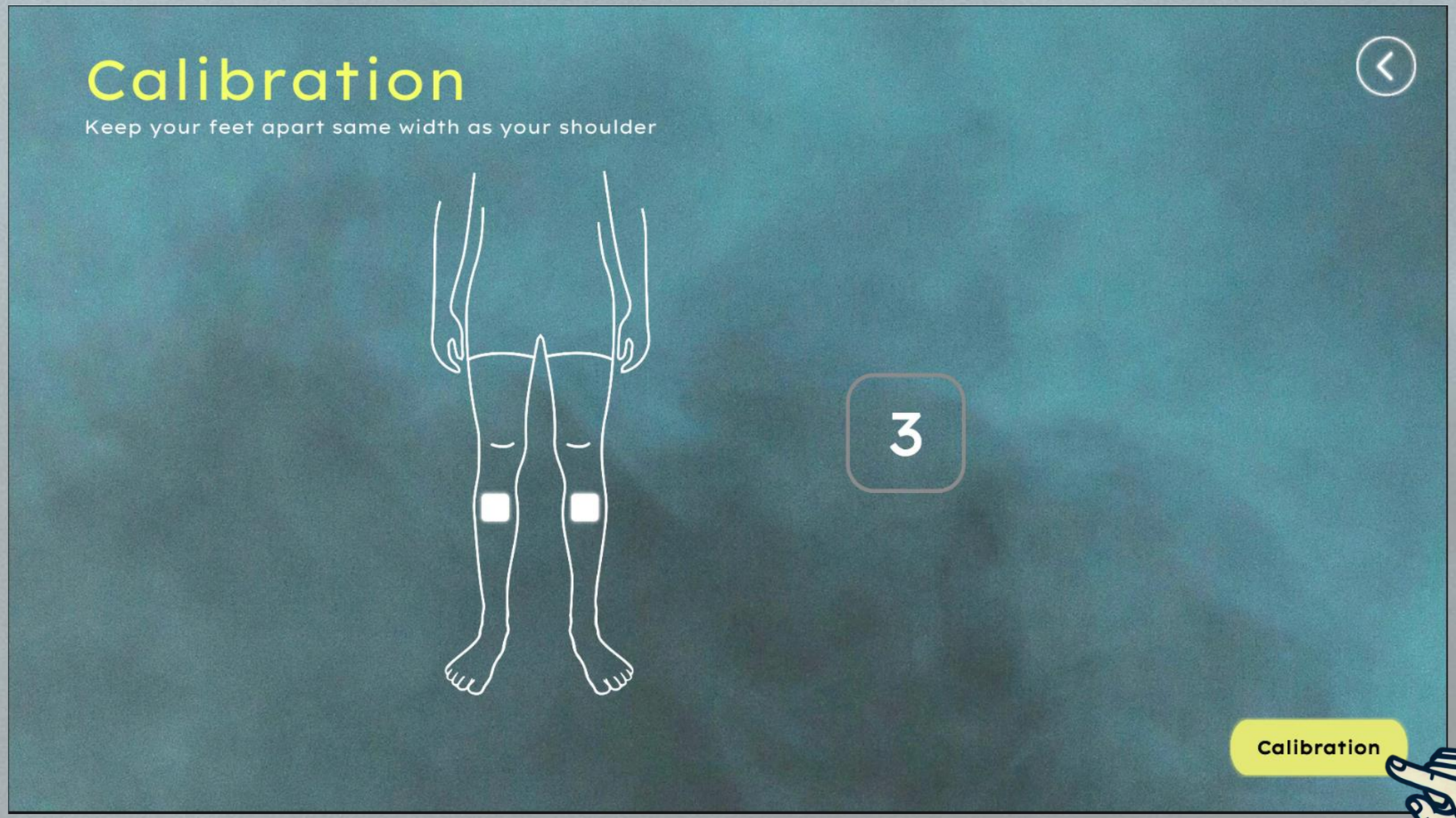
→ Step1: Drag each sensor to its intended joint location
(The icon turns yellow if a sensor is unstable)

(Auto Binding: automatic assignment)

→ Step2: Tap Next

→ Tap : shows the operation walkthrough

# User Guide - TEKFIT Pro

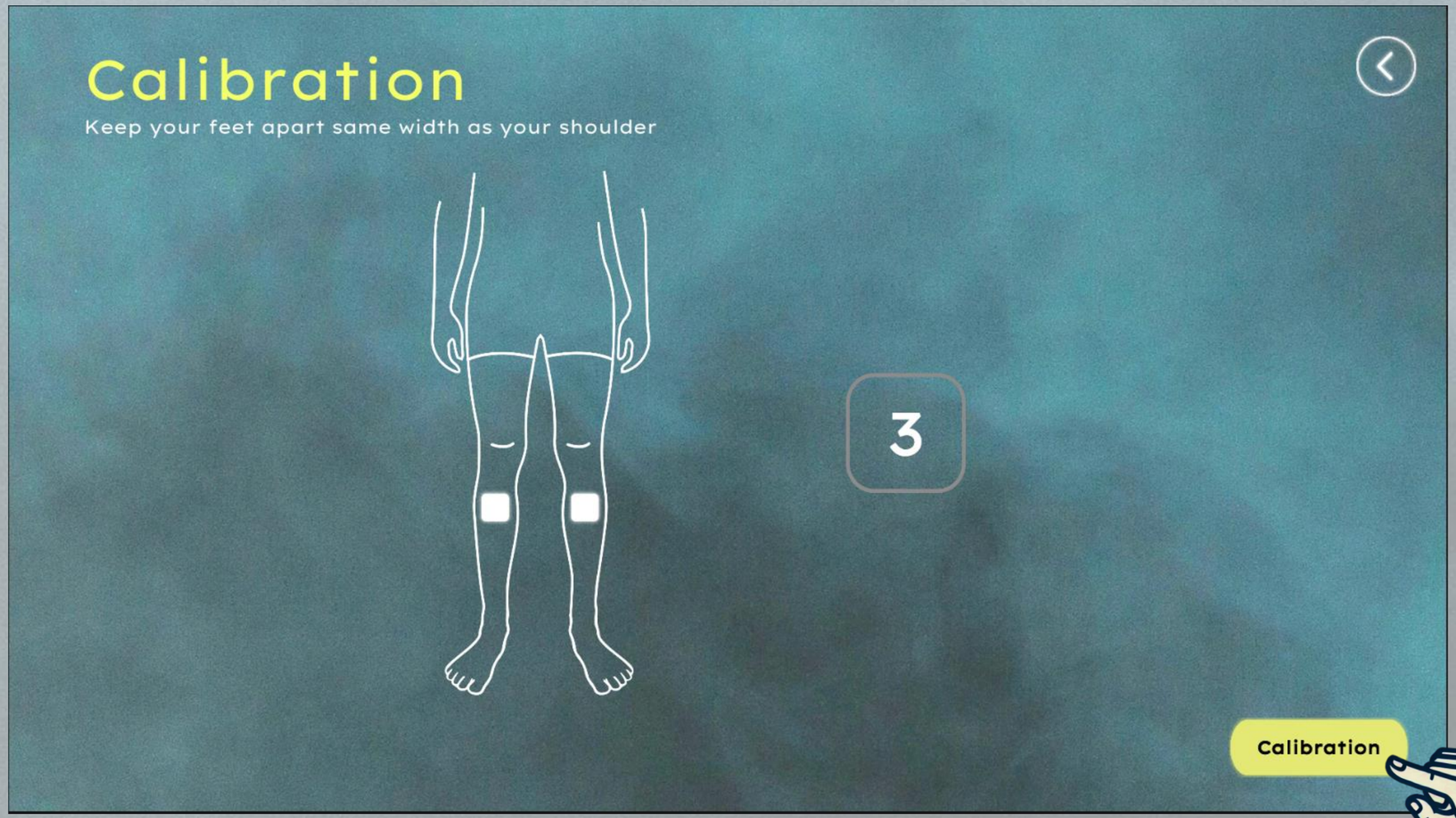



## Calibration

→ Step1: Have the client stand naturally with both feet; remove cycling cleats if worn.

→ Step2: Press Cailbration, and have the client hold the standing position without moving for 3 seconds.

# User Guide - TEKFIT Pro

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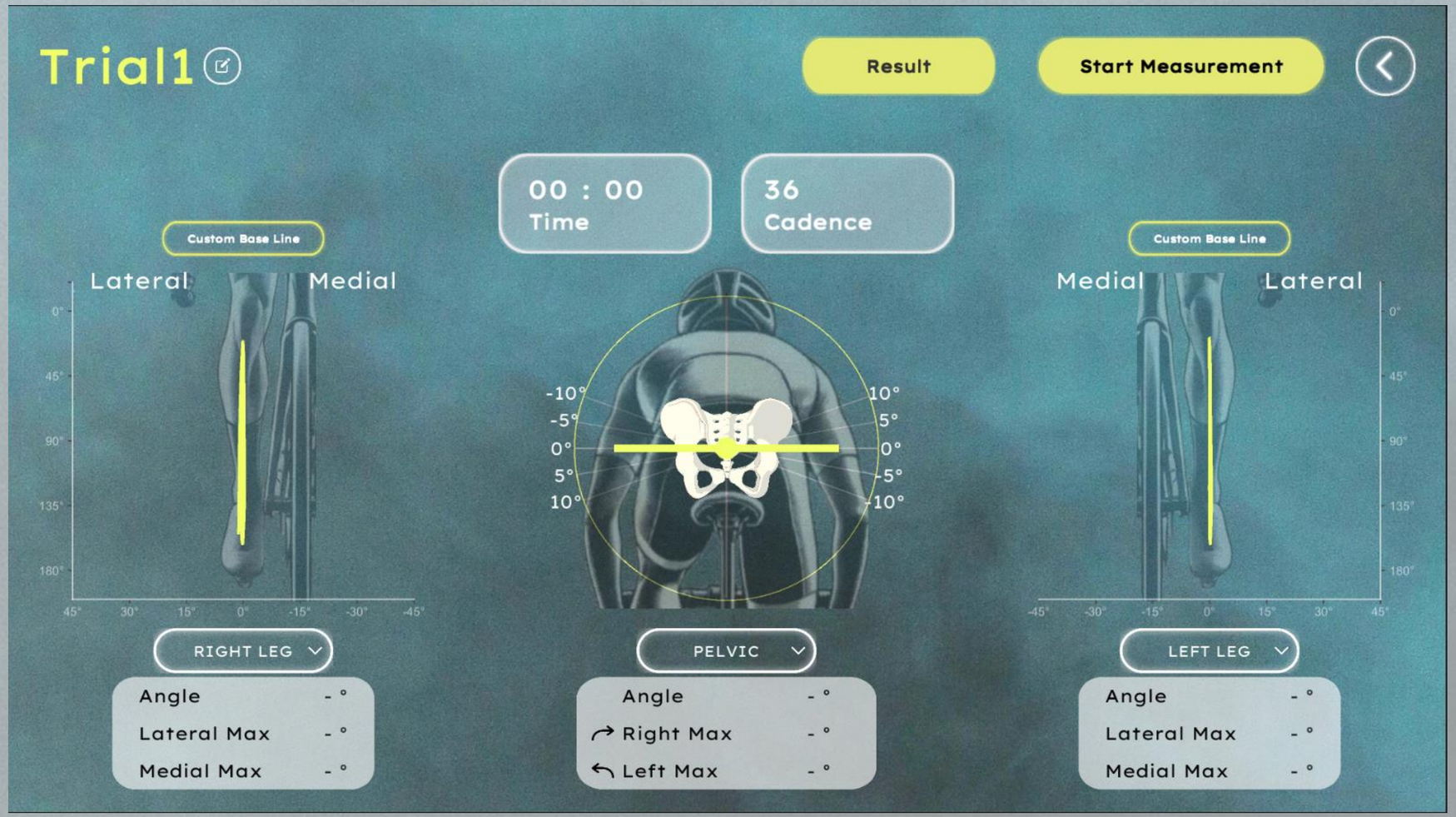



## Start Measurement

→ Step1: Have the client get on the bike

→ Step2: Start pedaling

→ Step3: Tap Start Measurement — no time limit

→ Step4: Tap Stop Measurement

→ Step5: Tap Result

(Custom Base Line: a custom reference centerline you may optionally use — e.g. defining it at bottom dead center sets the lower-limb centerline to that position)

# User Guide - TEKFIT Pro


## Result

→ Test note (Enter Trail Name)

→ Shows multiple trials (Multi Trial)

→ Shows motion trajectory (Trajectory)

→ Video Playback

→ Suggested adjustments (Recommendation)

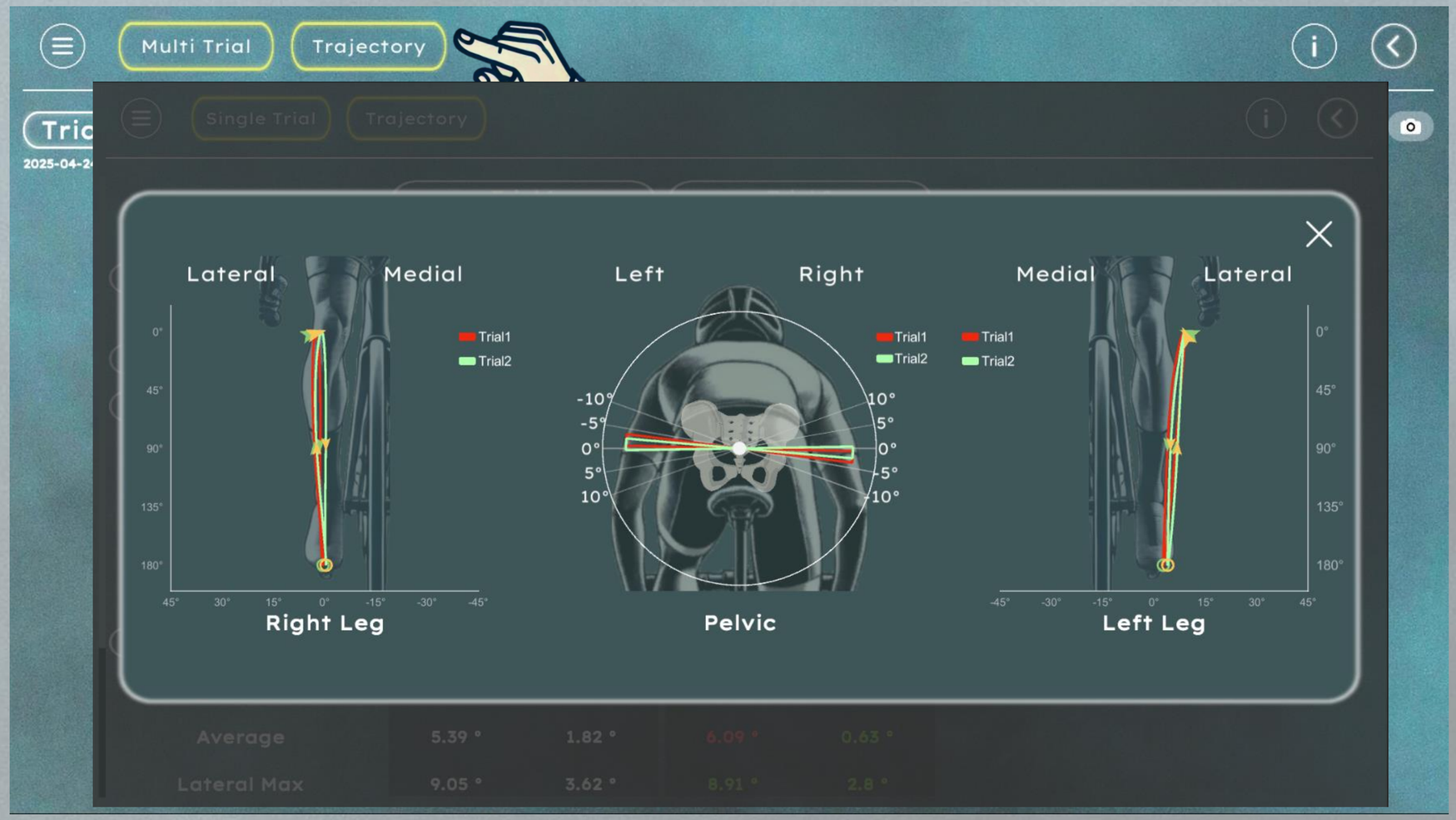
→ Top/bottom dead center slope >3 ° : adjust cleat position

→ $\frac{\text{TDC Power–Zone Angle Range}}{\text{BDC Recovery–Zone Angle Range}} > 3$ : adjust crank length

→ Excessive sway area > 300: adjust seat height

→ Other: add shoe insoles

# User Guide - TEKFIT Pro

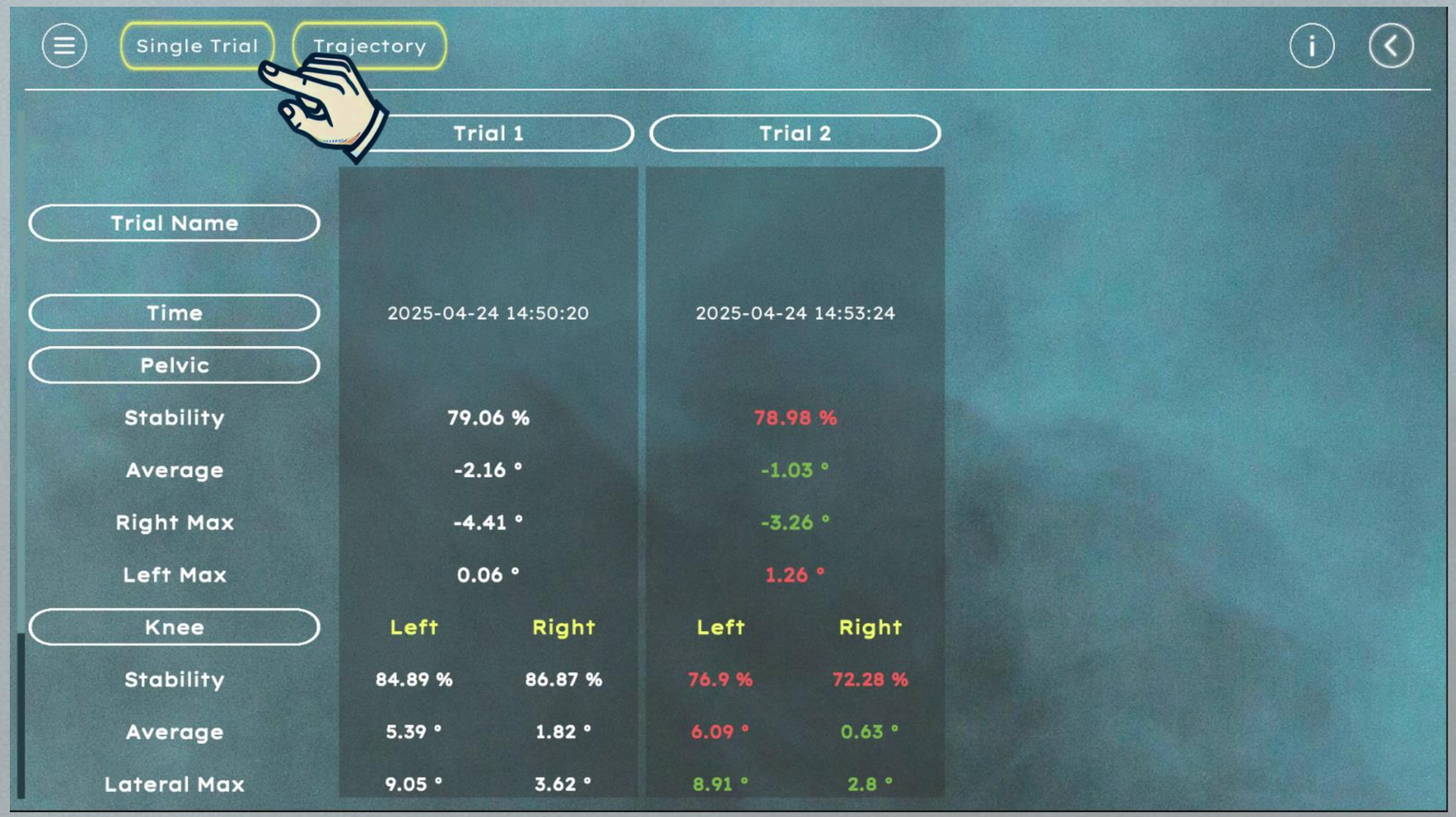



## Trajectory

→ Shows motion trajectory (Trajectory)
- → Trail 1
- → Trail 2

Tap Trail1 or Trail2 to toggle / its display

# User Guide - TEKFIT Pro

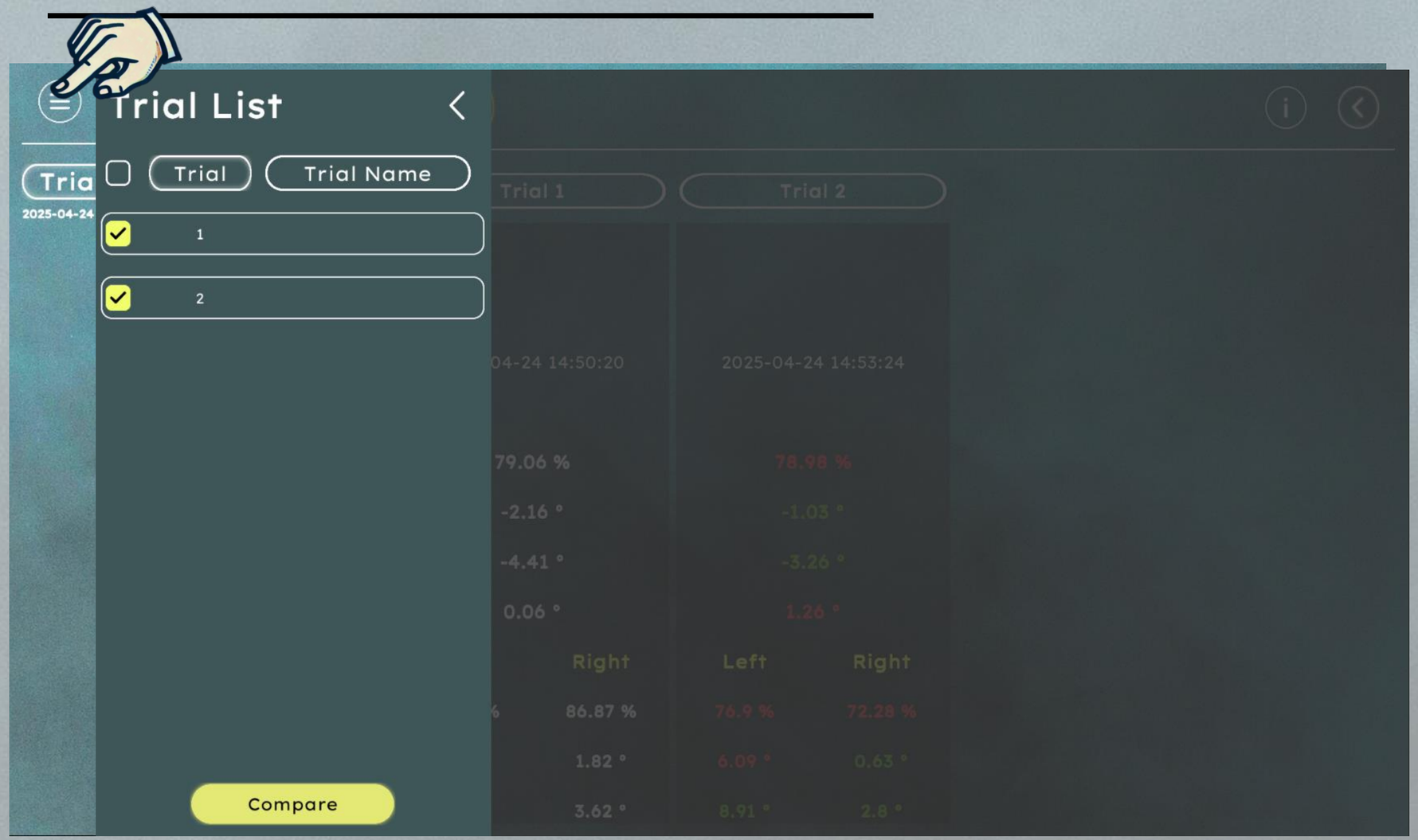



## Result

→ Tap multiple data sets (Multi Trial)

→ Multi Trial/Single Trial: switch anytime

# User Guide - TEKFIT Pro




Multi Trial

→ Tap

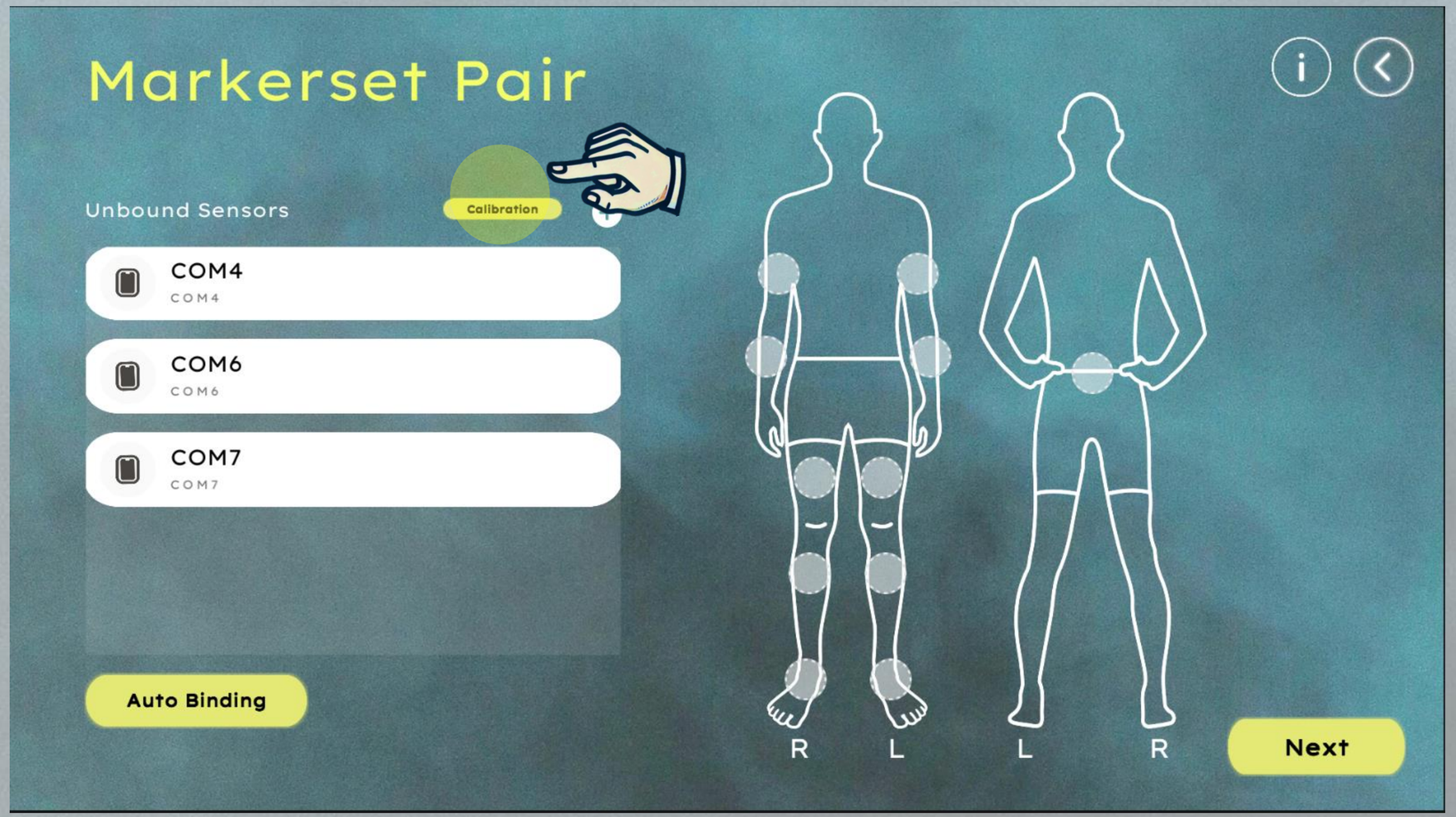
→ Check the Trials to compare

# User Guide - TEKFIT Pro


## Bike Fitting

→ Step1: Tap Bike Fitting (Single-side joint angle measurement)
Elbow
Shoulder
Torso
HipMax
HipMin
KneeMax
KneeMin
AnkleMax
AnkleMin
AnkleRange

# User Guide - TEKFIT Pro



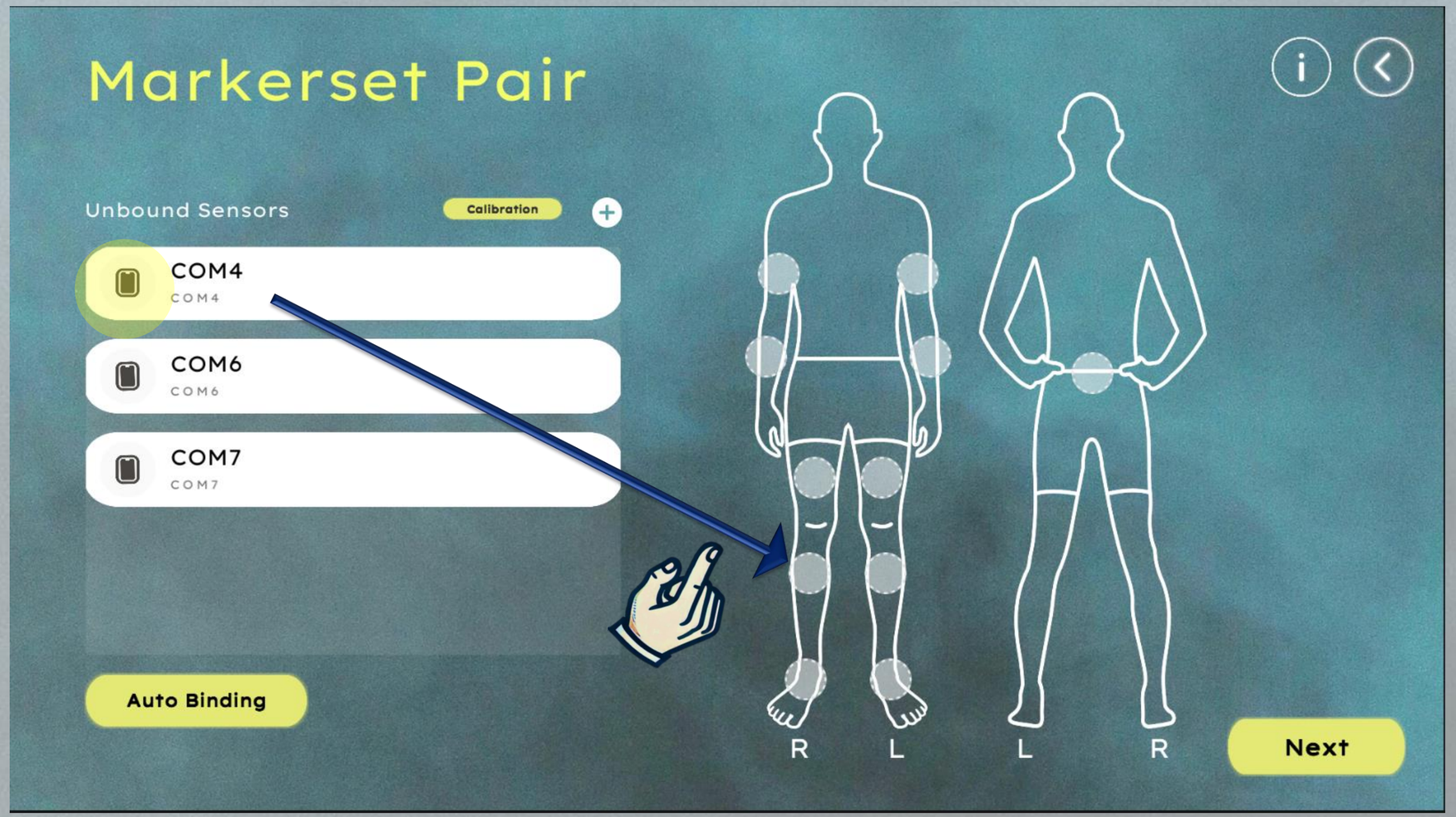

## Sensor Horizontal Placement Calibration

→ Step1: Place the sensor flat on a table free of magnetic interference

→ (Keep at least 30cm away from speakers, metal, motors, and electrical devices)

→ Step2: Tap Cailbration

# User Guide - TEKFIT Pro




## Sensor Placement Setup

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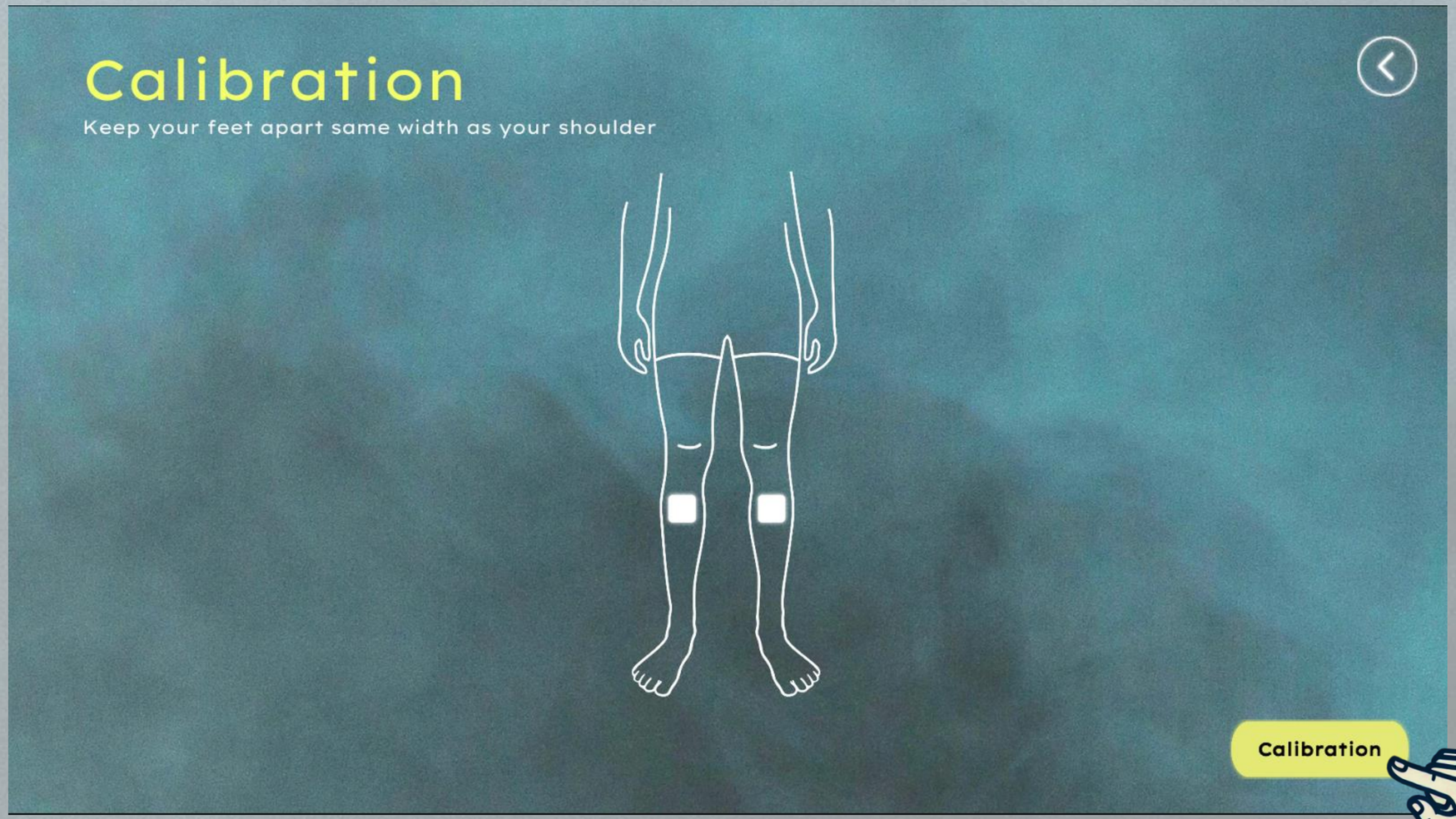
(The icon turns yellow if a sensor is unstable)

(Auto Binding: automatic assignment)

→ Step2: Tap Next

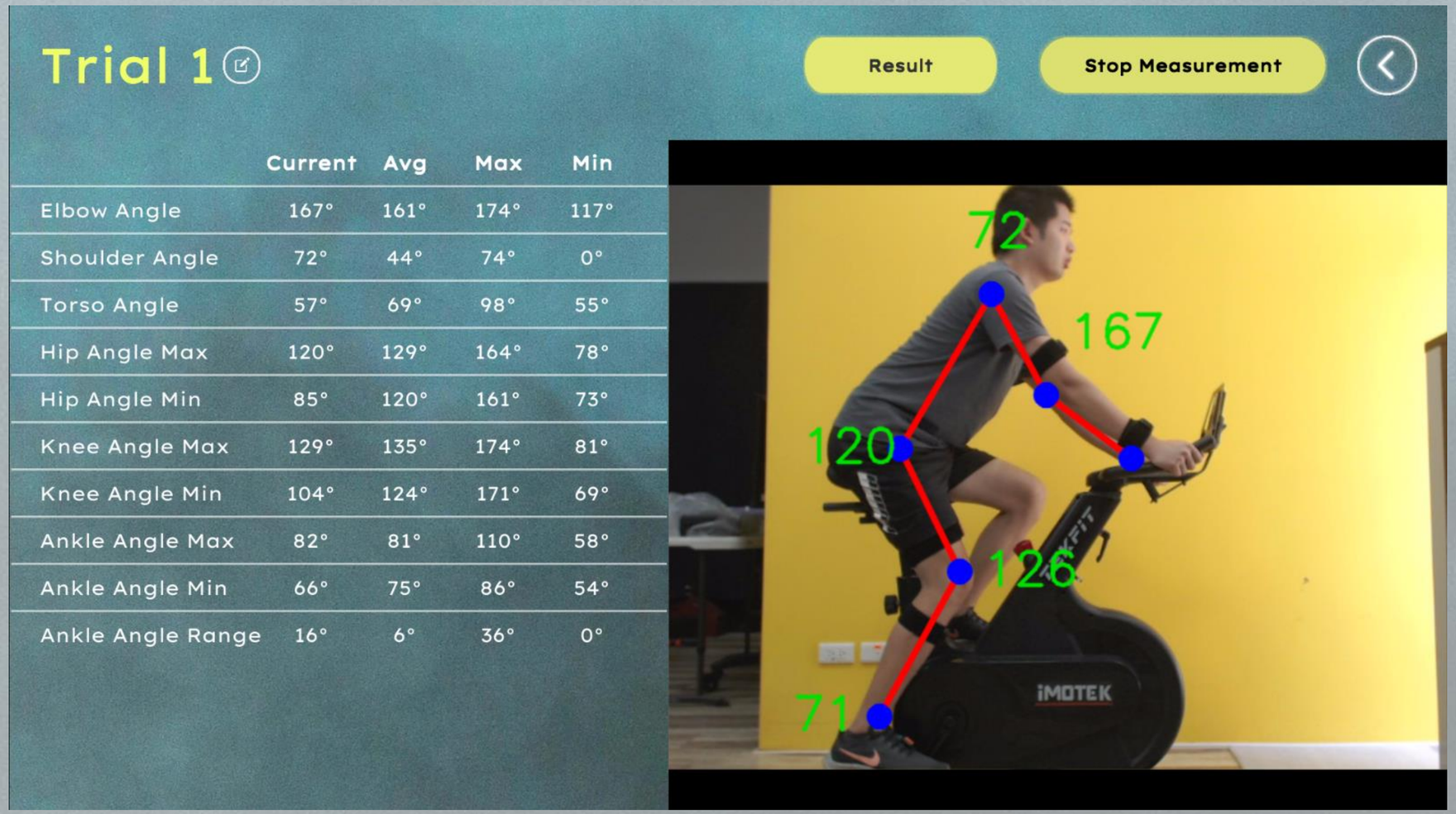
# User Guide - TEKFIT Pro




## Calibration

→ Step1: Have the client stand naturally with both feet; remove cycling cleats if worn.
→ Step2: Press Cailbration.

# User Guide - TEKFIT Pro




## Start Measurement

→ Step1: Have the client get on the bike

→ Step2: Start pedaling

→ Step3: Tap Start Measurement — no time limit

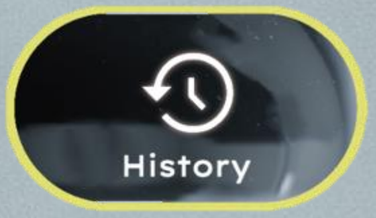
→ Step4: Tap Stop Measurement

→ Step5: Tap Result

## Note

MinRPM> 60
MaxRPM> 100

# User Guide - TEKFIT Pro






History, Bike Fitting

→ Search for Su
Keywords: name, phone number, date

→ Tap to view subject data

History:
Measurement — motion measurement history

Bike Fitting History:
Bike Fitting measurement history

# User Guide - TEKFIT Pro


## History

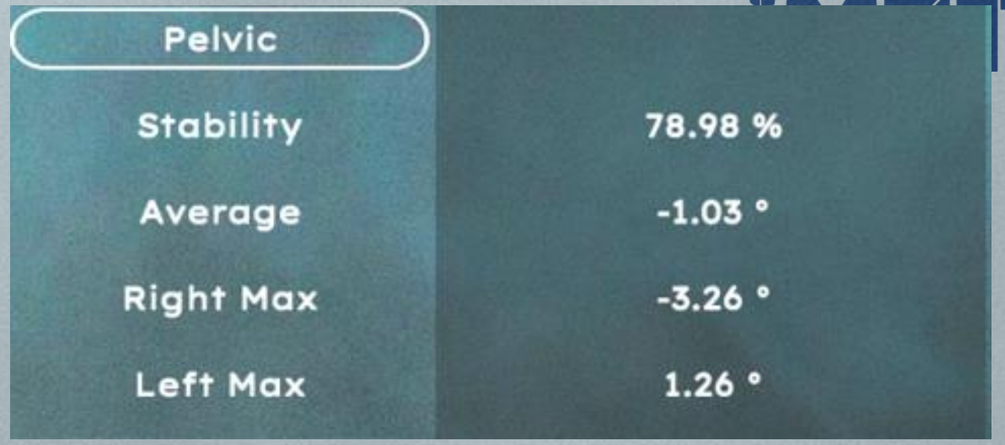
→ Shows the subject's most recent record and past measurement history

→ Trial Count: number of data points in this measurement

→ CSV : Raw data (academic license)

→ PDF: Motion Performance Report
  → Explained in the next section

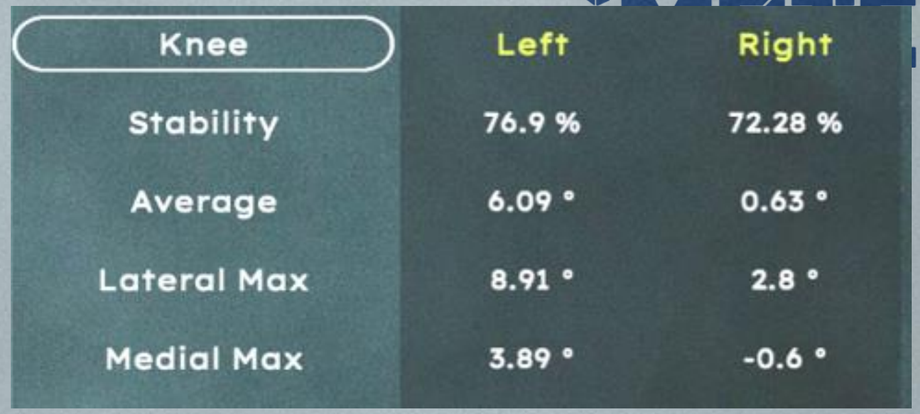
# User Guide - TEKFIT Pro




## Parameter Description:

| Pelvic | |
|---|---|
| Stability | Ability to maintain consistent motion during measurement. Higher stability indicates greater movement consistency, helping to reduce injury risk and improve overall performance. |
| Average | The average left-right pelvic sway angle during measurement, used to assess pelvic stability and symmetry during cycling. |
| Right Max | The maximum angle the pelvis sways to the right, indicating its furthest rightward range — useful for assessing right-side pelvic range of motion. |
| Left Max | The maximum angle the pelvis sways to the left, indicating its furthest leftward range — useful for assessing left-side pelvic range of motion. |

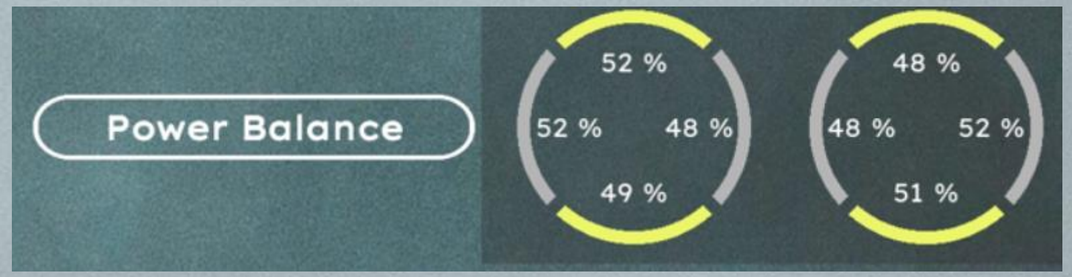
# User Guide - TEKFIT Pro




## Parameter Description:

| Knee | |
|---|---|
| Stability | Ability to maintain consistent motion during measurement. Higher stability indicates greater movement consistency, helping to reduce injury risk and improve overall performance. |
| Average | The average medial-lateral swing angle of the knee, showing the average degree of adduction/abduction during measurement — useful for analyzing symmetry and coordination of knee motion. |
| Lateral Max | The maximum angle the knee abducts outward (laterally) — this value helps assess the knee's range of motion. |
| Medial Max | The maximum angle the knee adducts inward (medially) — this value helps assess the knee's range of motion.<br>(0° : represents the leg angle in a natural standing position; a positive value (+) indicates abduction, a negative value (-) indicates adduction.) |

# User Guide - TEKFIT Pro




## Parameter Description:

| Power Phase | |
|---|---|
| Left-Right Balance | This parameter represents the ratio of power output between the left and right legs, helping assess whether force application is balanced during measurement. Higher balance indicates better bilateral coordination and helps improve overall performance.<br>Four movement phases:<br>① Phase1 — Top Dead Center: 315° ~ 45°<br>② Phase2 — Power Phase: 45° ~ 135°<br>③ Phase3 — Bottom Dead Center: 135° ~ 225°<br>④ Phase4 — Recovery Phase: 225° ~ 315° |

# Report Walkthrough

iMOTEK

TekFit Report

Basic information

User Name: User1 | Date: 11-16-2021-01-06-25 | Total time: 1.05min | RPM: 66.58

Height: ---cm | Weight: --Kg | Gender: -- | Age: --yr

# Motion Type Result

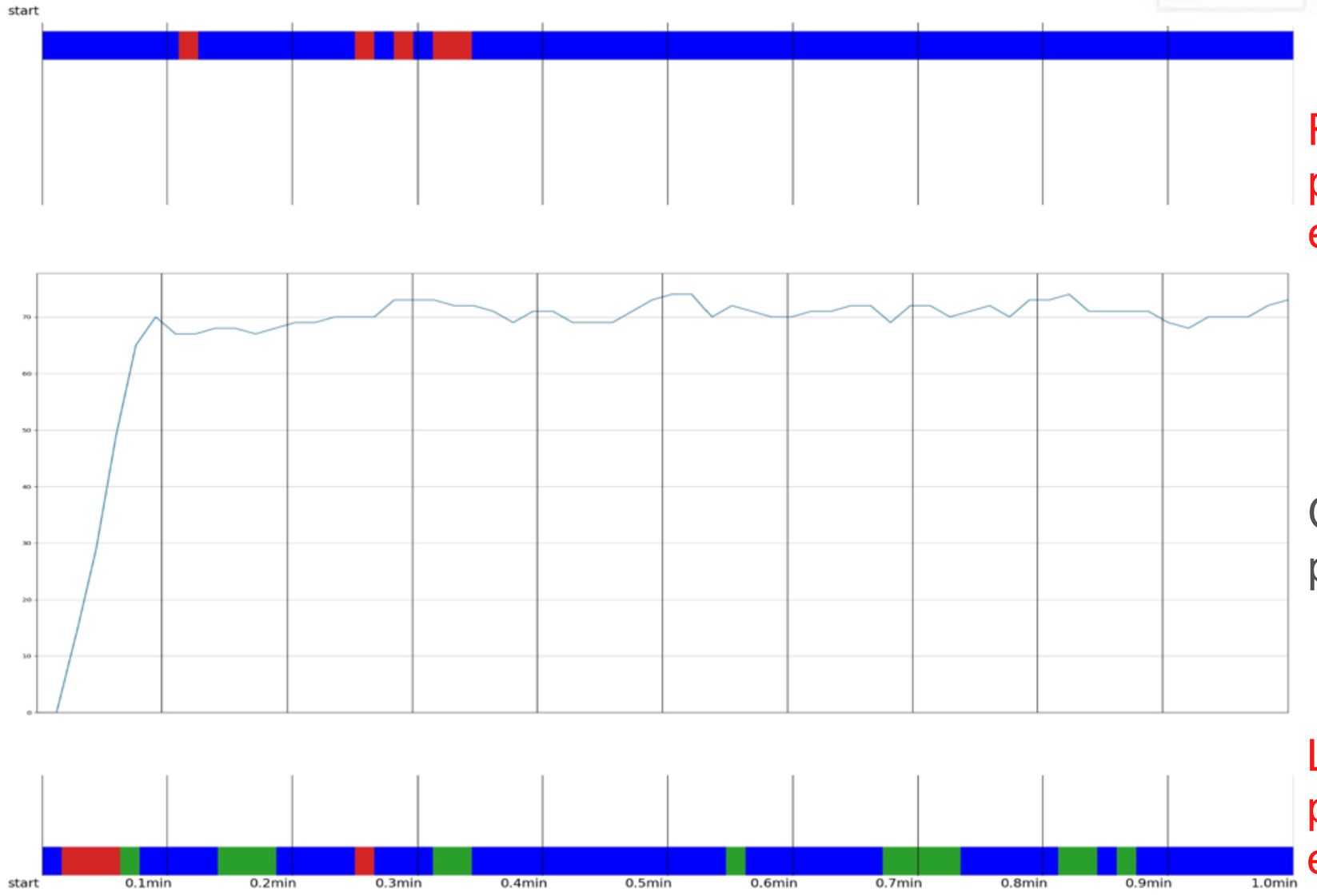
Overview of riding pattern for the entire ride

| Motion Type Result | | |
|---|---|---|
| Knee Motion | Right | Left |
| Motion Type | Normal | Normal |
| Medial Percent | 0.0% | 22.0% |
| Normal Percent | 92.0% | 71.0% |
| Lateral Percent | 8.0% | 6.0% |

Overall Rating
Valgus
Normal
Varus

# Motion Type Result

Blue = Normal
Green = Varus
Red = Valgus

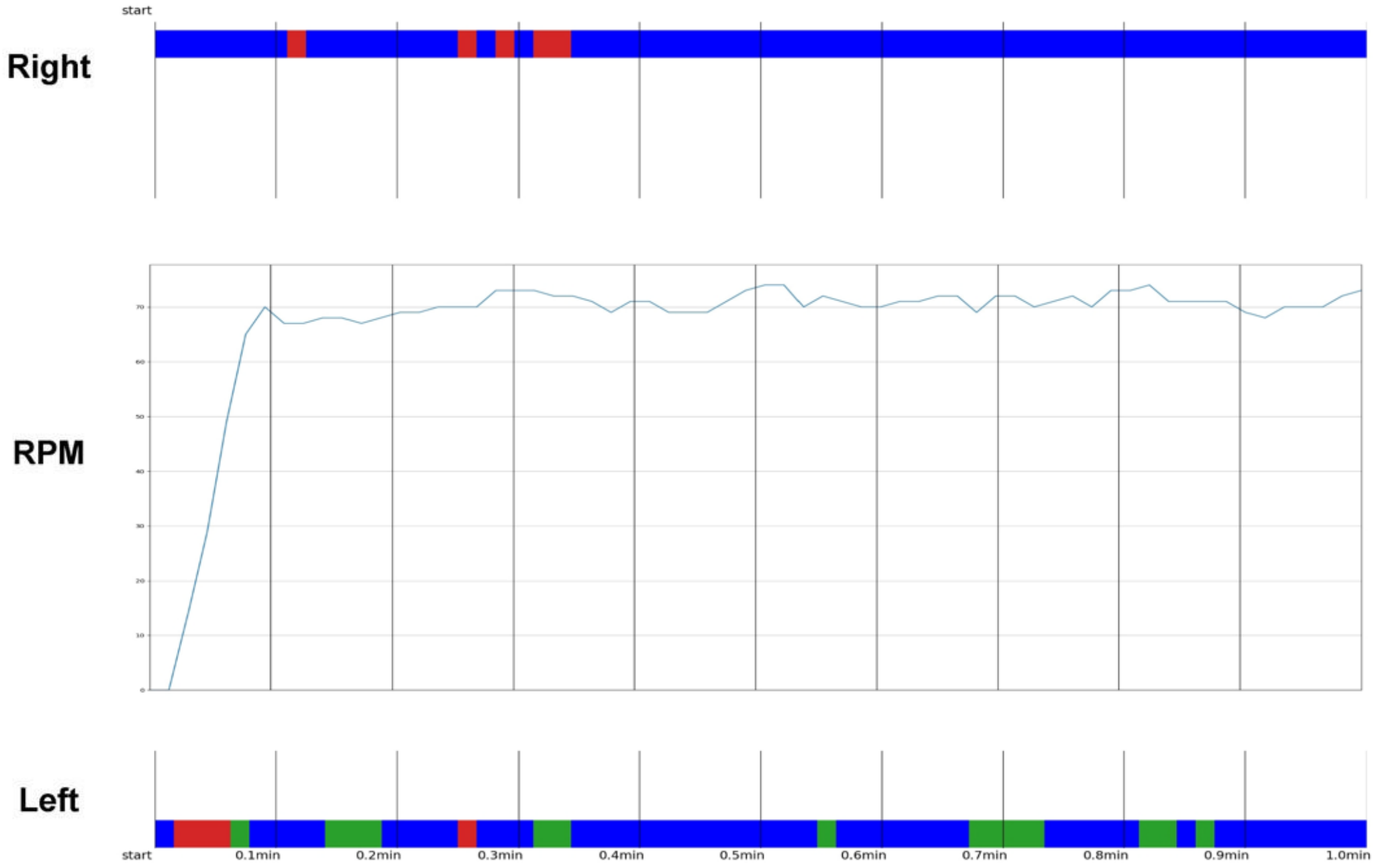



Right foot posture performance in each pedal cycle

Cadence (revolutions per minute, RPM)

Left foot posture performance in each pedal cycle

# Motion Type Result




- **Changes in riding speed affect riding posture**

  - How to pace yourself?

  EX: Match training intensity (heart rate zone)

  - How to maintain correct posture?

  EX: Static bike-frame adjustment, muscle activation training

- **Over time, fatigue causes postural instability**

  - How to train muscles for better fatigue resistance?

  Ex: Muscular endurance training, aerobic training, targeted muscle-group training

  - How to maintain correct posture?

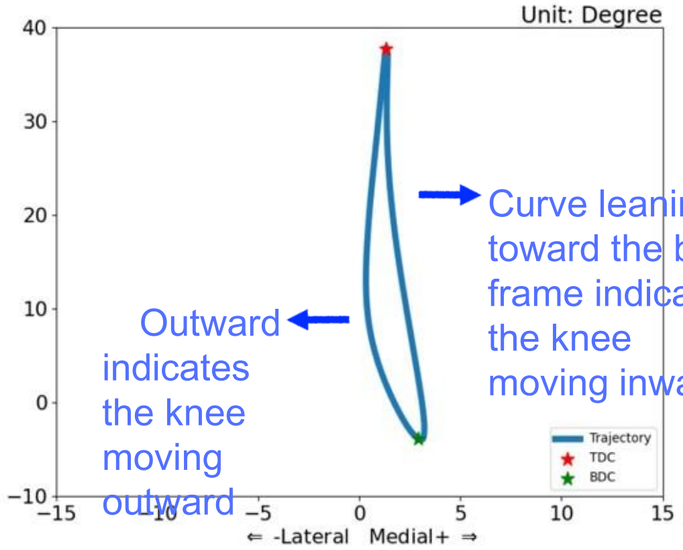
  Ex: Technique education, repeated practice, strength training

# Trajectory Result

## Trajectory Result

| Knee | Right | Left |
|---|---|---|
| Min Angle and Phase | -3.43 degree in Phase 3 | -3.56 degree in Phase 3 |
| Max Angle and Phase | 0.04 degree in Phase 2 | 3.93 degree in Phase 1 |

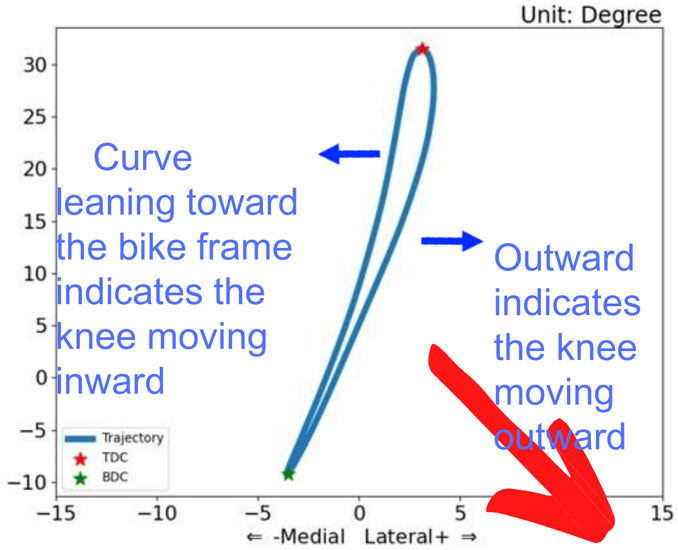
**Right**




Outward indicates the knee moving outward

Curve leaning toward the bike frame indicates the knee moving inward

**Left**




Curve leaning toward the bike frame indicates the knee moving inward

Outward indicates the knee moving outward

X : axis represents the knee moving inward or outward

Y : axis represents movement between top and bottom dead center

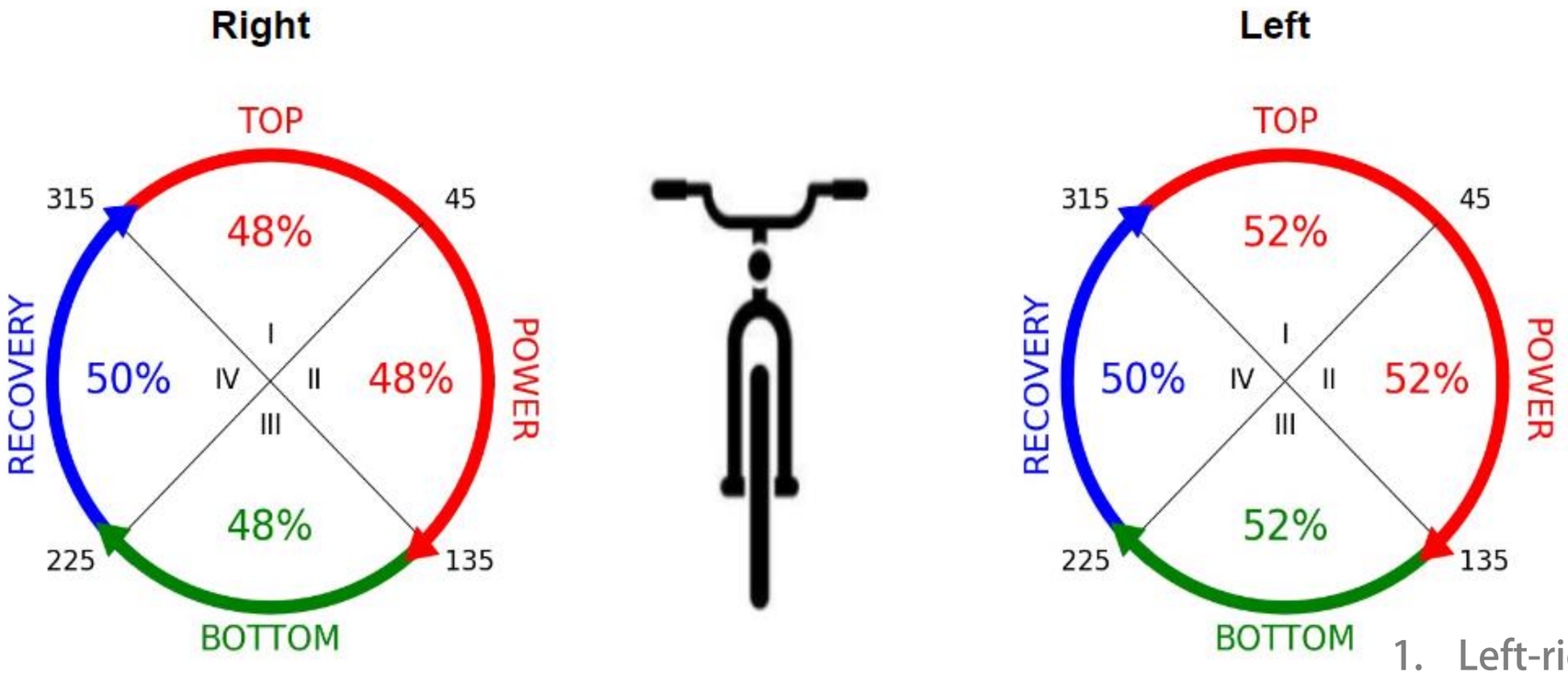
A larger enclosed curve area indicates greater sway

Blue curve = average motion trajectory for the entire ride (AVG)

Your right leg motion range is about 3.47 degree and left leg is about 7.49 degree

# Cycling Speed Result

## P o w e r




1. Left-right power distribution percentage
2. Pedaling Phase
   - I-TOP = Top Dead Center (pre-power phase)
   - II-POWER = Power Phase
   - III-BOTTOM = Bottom Dead Center
   - IV-RECOVERY = Recovery Phase

# Cycling Speed Result

## Cycling Stable Result

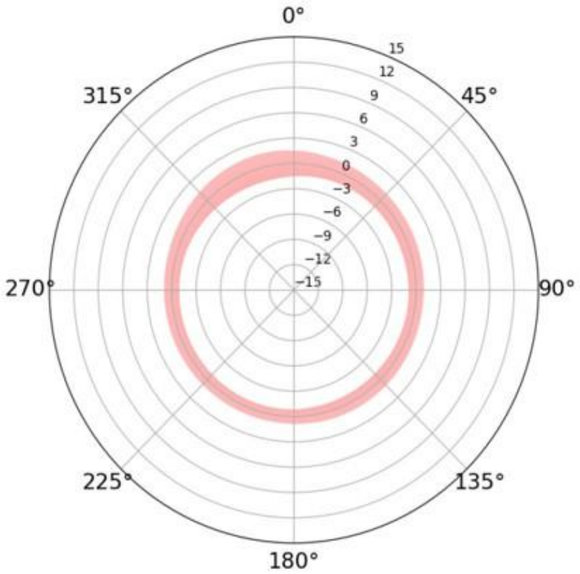
| Rnage 0-360 | Right | Left |
|---|---|---|
| Stable | 70.42% | 59.4% |
| Average Std Angle | 0.66 degree | 0.8 degree |

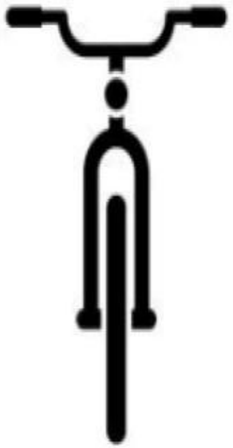
Stability: the higher the value, the greater the stability

Average instability angle across the entire ride

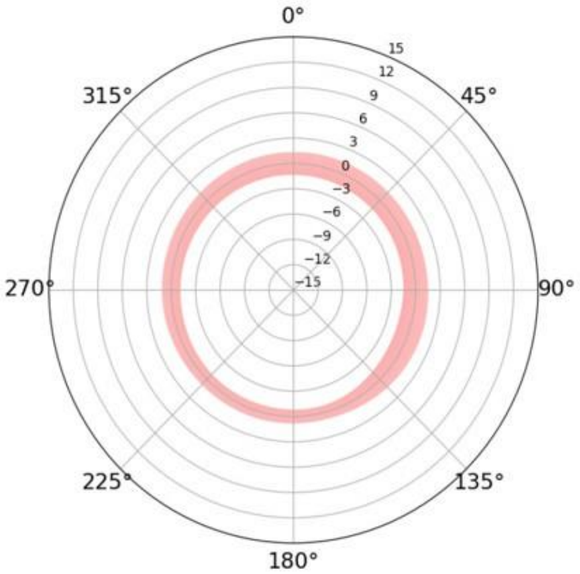
This value represents ±0.8 degree

**Right**



**Left**




## Chart Explanation:

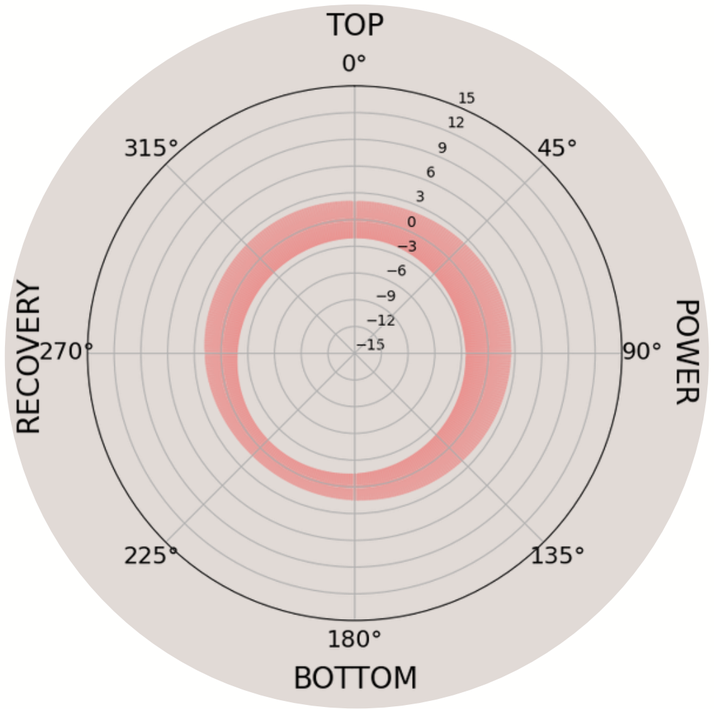
1. Pedal stroke 0~360˚, stability breakdown
2. A larger red area indicates greater joint instability and more muscle energy consumed

(See the next page for details on the muscle groups engaged at each point in the 0~360˚ pedal stroke)

# Cycling Speed Result

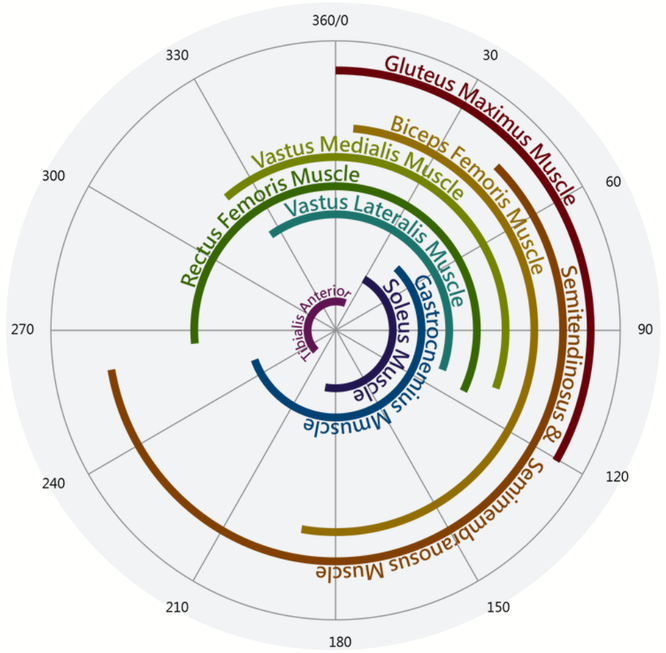
## - REPORT -

### MOVEMENT PHASE ANALYSIS



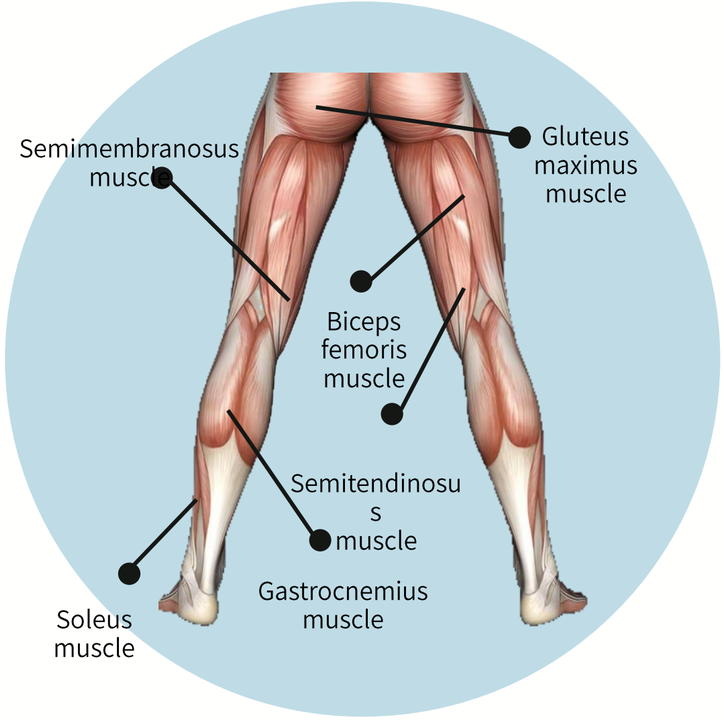

## - INSTRUCTION -

### Corresponding muscle timing chart



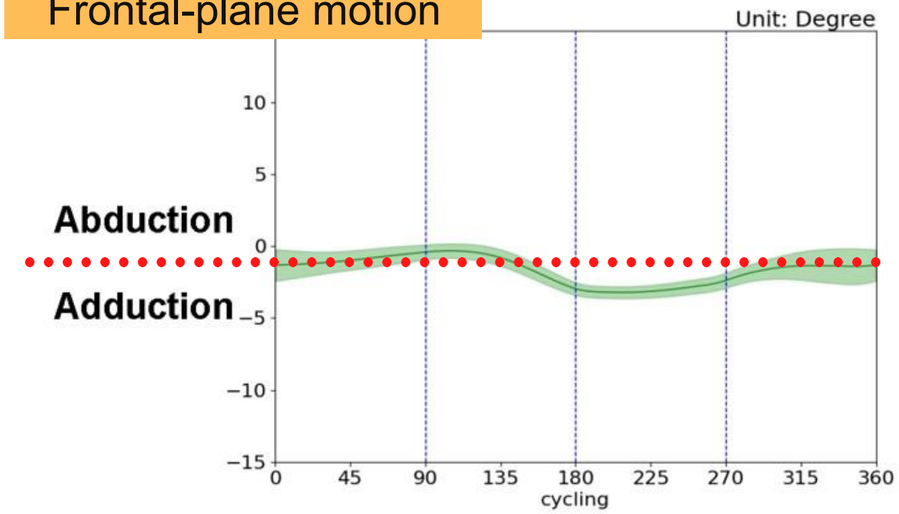

## - APPLICATION -

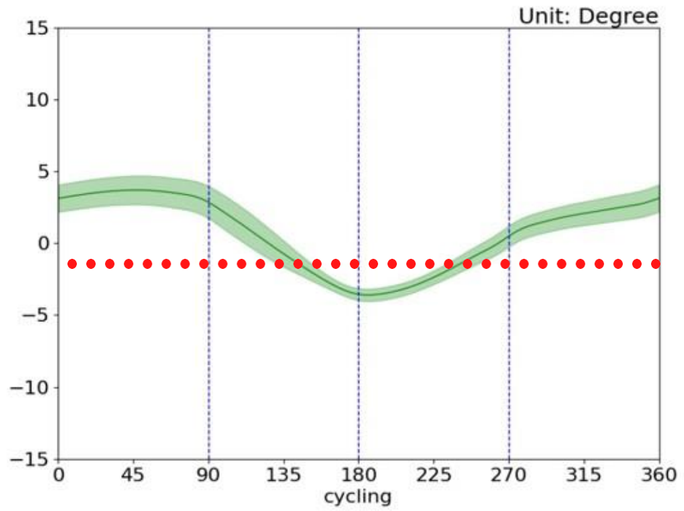
### LOWER LIMB MUSCLE GROUPS



# Cycling Stable Result

## Frontal-plane motion



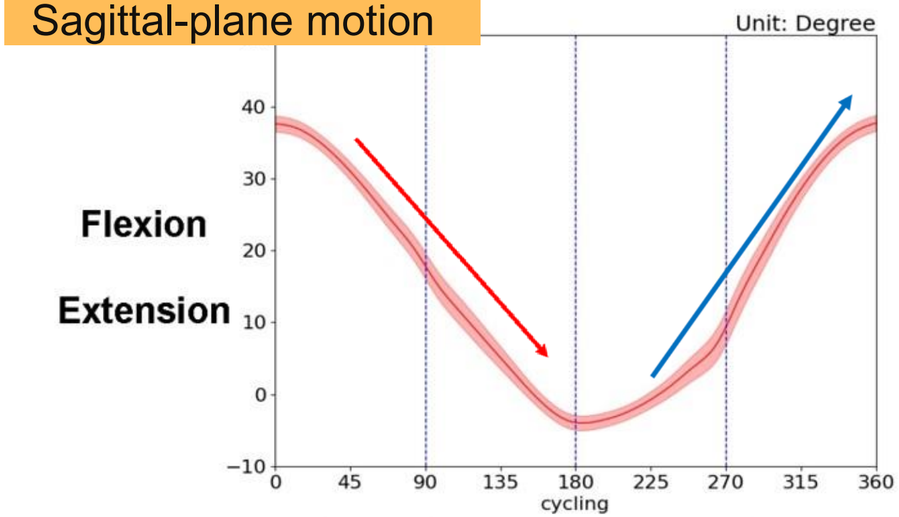

**Abductor muscle group**
- **Gluteus maximus**
- **ensor fasciae latae**

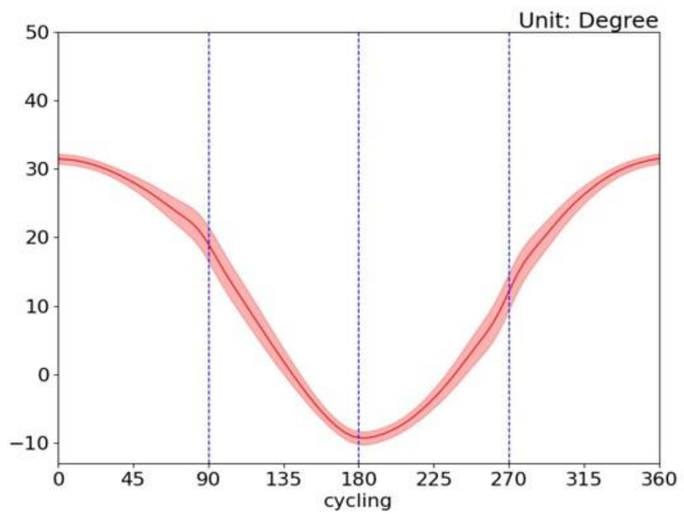
A positive value indicates knee varus (bow-legged, toes-out stance)

A negative value indicates knee valgus (knock-kneed, toes-in stance)

**Adductor muscle group**
- **Adductor longus**
- **Adductor brevis**
- **Gracilis**

## Sagittal-plane motion




Curve pointing downward indicates the thigh is extended

Curve pointing upward indicates the thigh is flexed

**Extension Motion**
- **Thigh muscle group**
- **Posterior lower-leg muscle group**

**Flexion Motion**
- **Posterior thigh muscle group**
- **Anterior lower-leg muscle group**

The charts above and below show the knee's inward/outward and flexion angle across the ride cycle, divided into the 0~360° movement phase — a larger shaded area indicates greater riding instability