Empower Human Motor Dynamics

Anytime. Anywhere. Through Wearable Technology

2014 Engenharia Biomédica
Universidade do Minho

2018 Erasmus
Politécnico di Milano

2019 Investigação
Universidade do Minho

2020 PhD
Universidade do Minho

2024 eDynamics Technologies

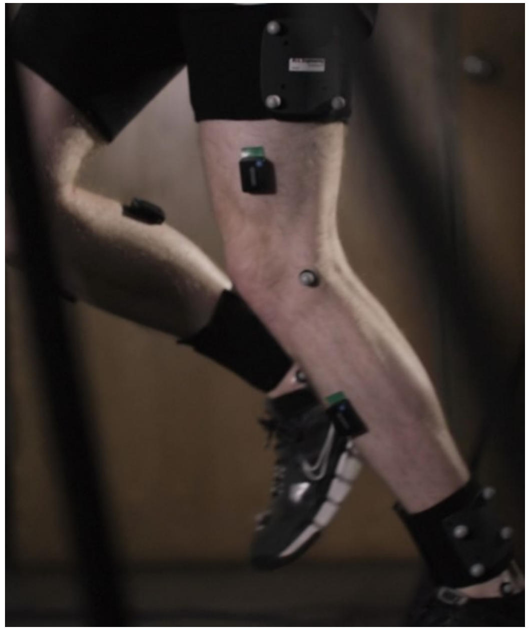
PhD - Neurolink

Bio-inspired Control for a Lower Limb Neuroprosthesis towards Motor Reestablishment

Sensors

Motion Sensors

Muscle Activation Sensors



Pressure Sensors

Actuators

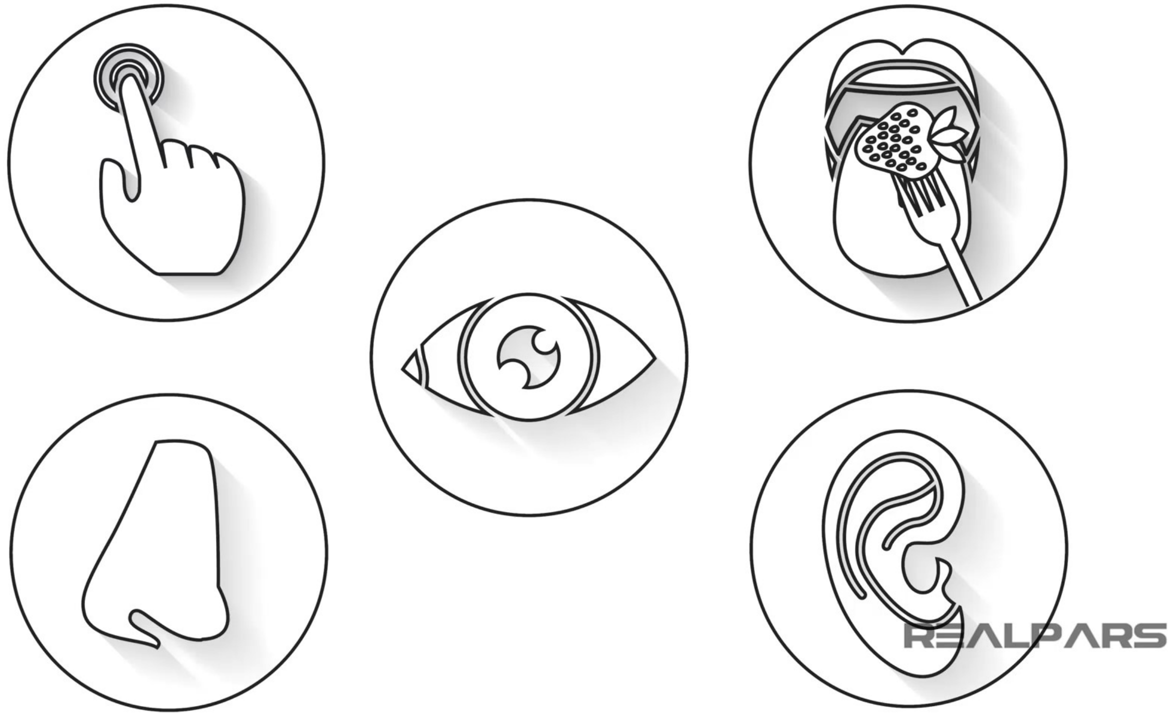
Orthosis / Exoskeleton

Functional Electrical Stimulation

Sensor Systems

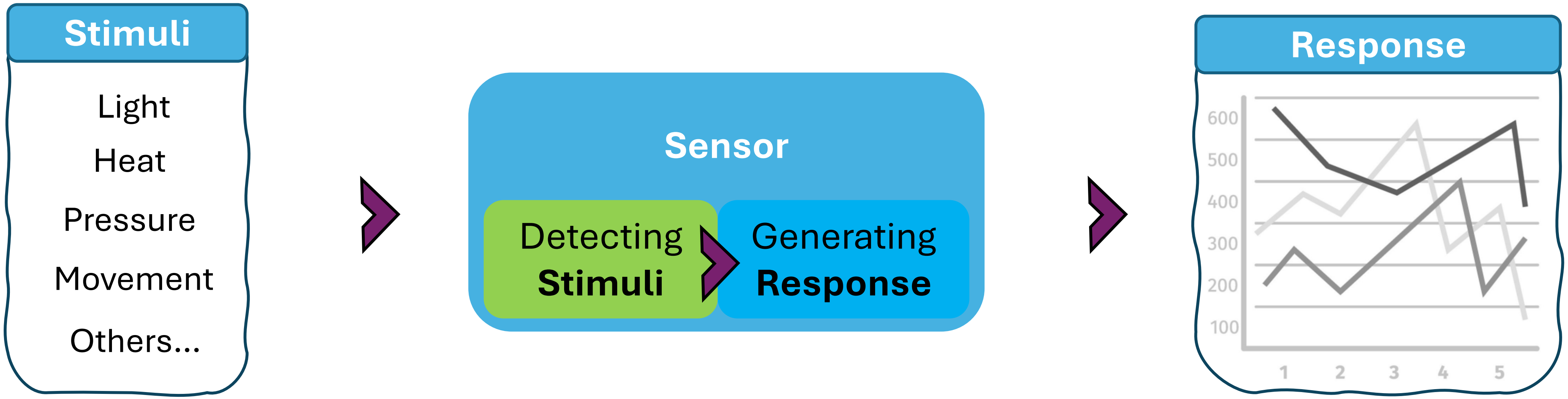
Human Sensors

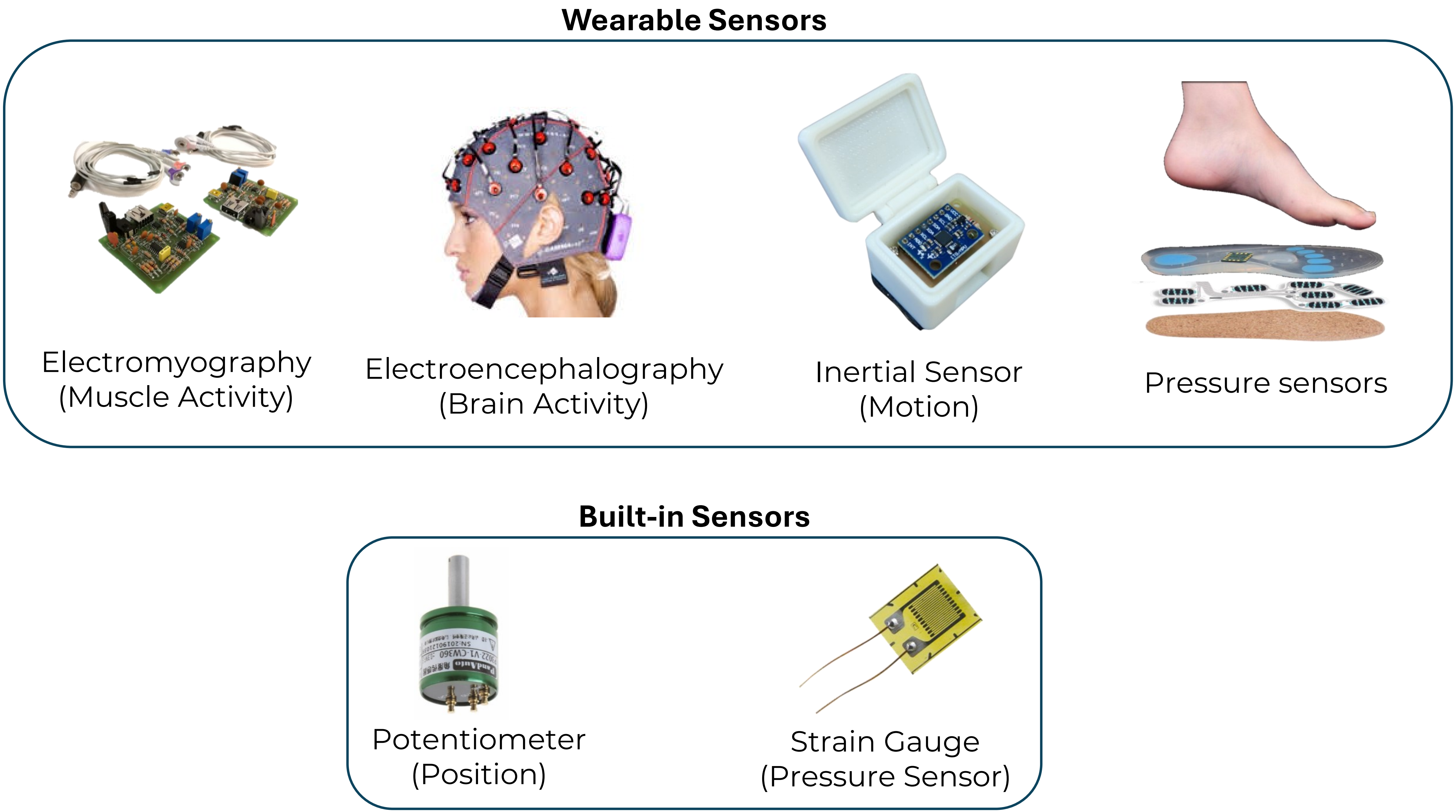
- ❑ Eyes
- ❑ Skin
- ❑ Ears
- ❑ Nose
- ❑ Mouth



Sensors Operation

Detect and Respond to **Stimuli**

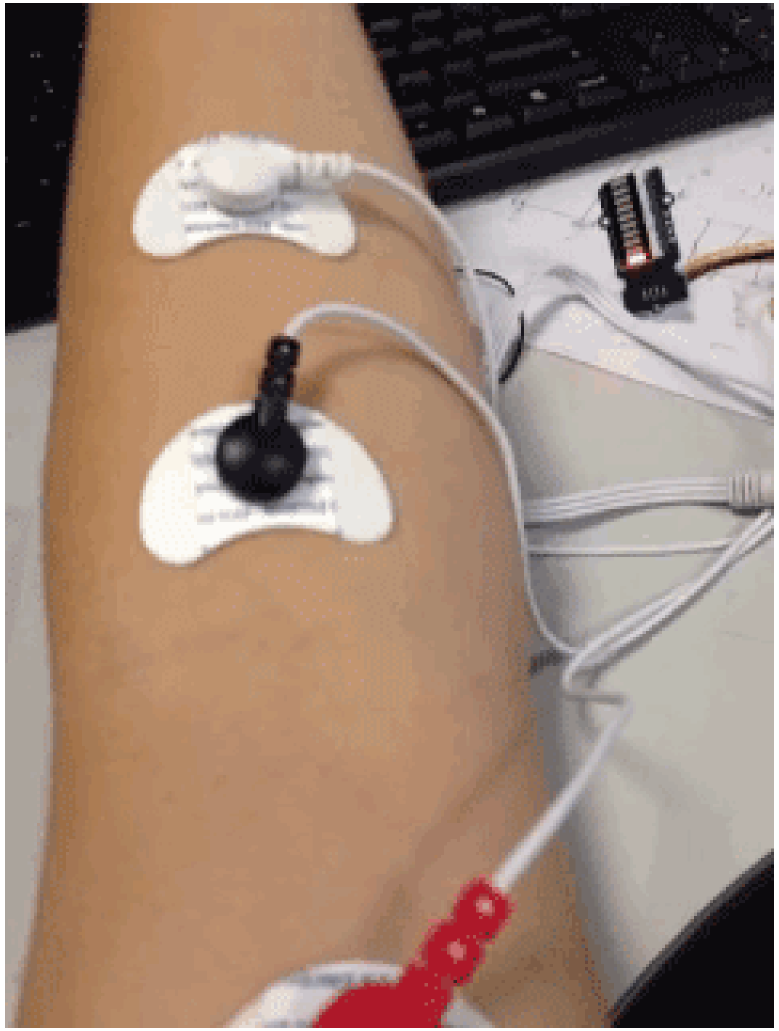



Wearable Sensors
Electromyography
(Muscle Activity)
Electroencephalography
(Brain Activity)
Inertial Sensor
(Motion)
Pressure sensors
Built-in Sensors
Potentiometer
(Position)
Strain Gauge
(Pressure Sensor)

Electromyography

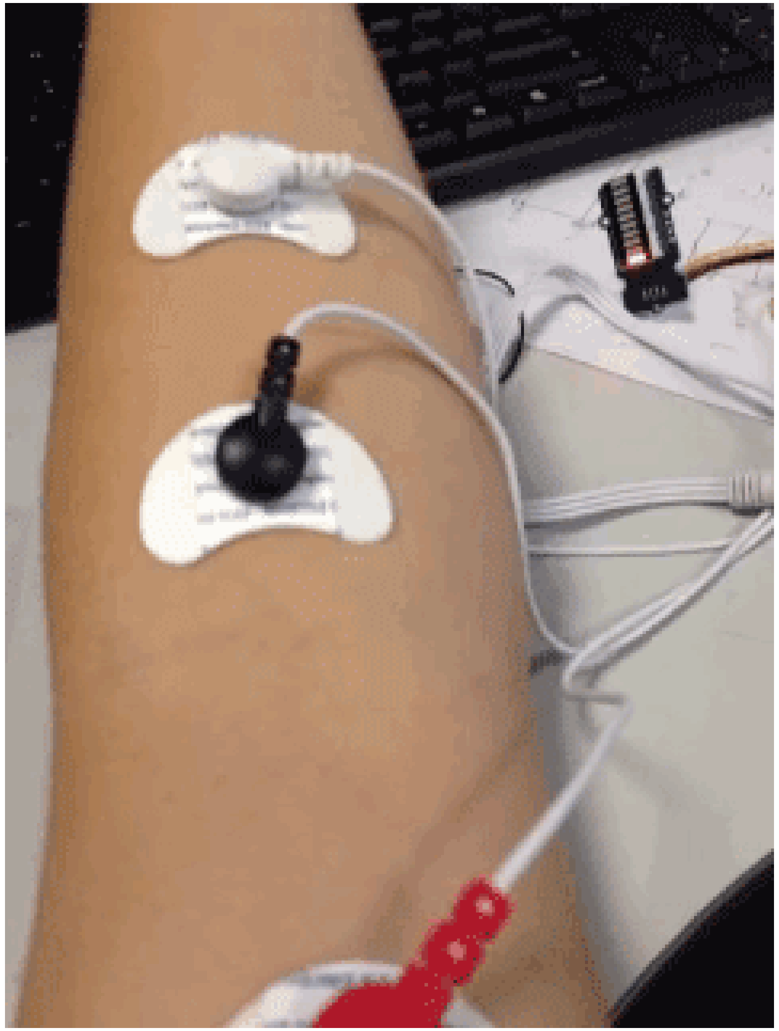
Sensors: EMG

- EMG is a technique for evaluating and recording the electrical activity produced by skeletal muscles.
- It is commonly used in medical diagnostics, prosthetics, and sports science.
- EMG sensors detect and measure the electrical signals generated by muscle contractions.



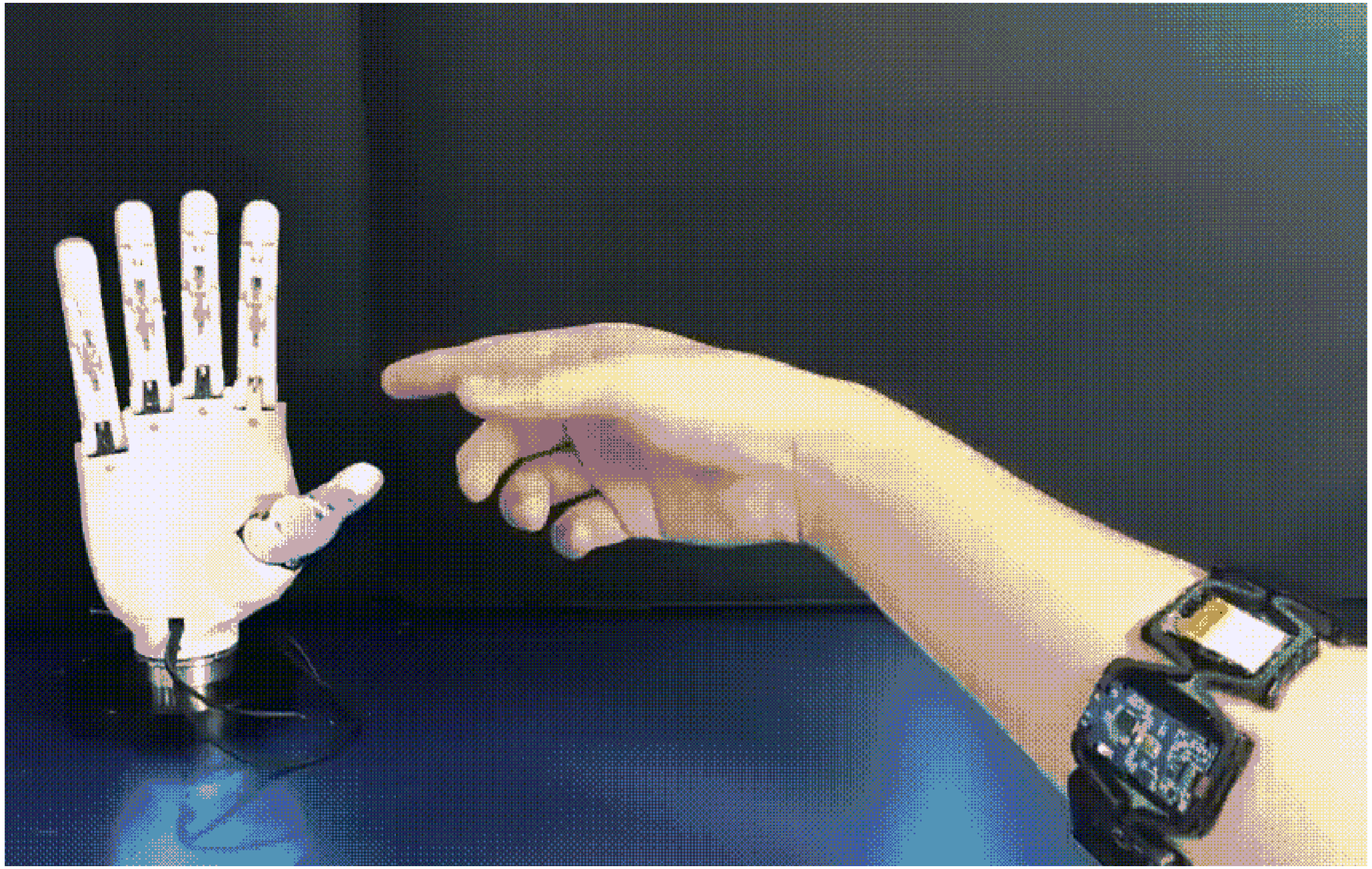
Sensors: EMG – How it works

- EMG sensors consist of electrodes placed on the skin surface or within the muscle.
- When a muscle contracts, it produces electrical signals that are detected by the electrodes.
- These signals are then amplified, filtered, and processed to provide information about muscle activity.



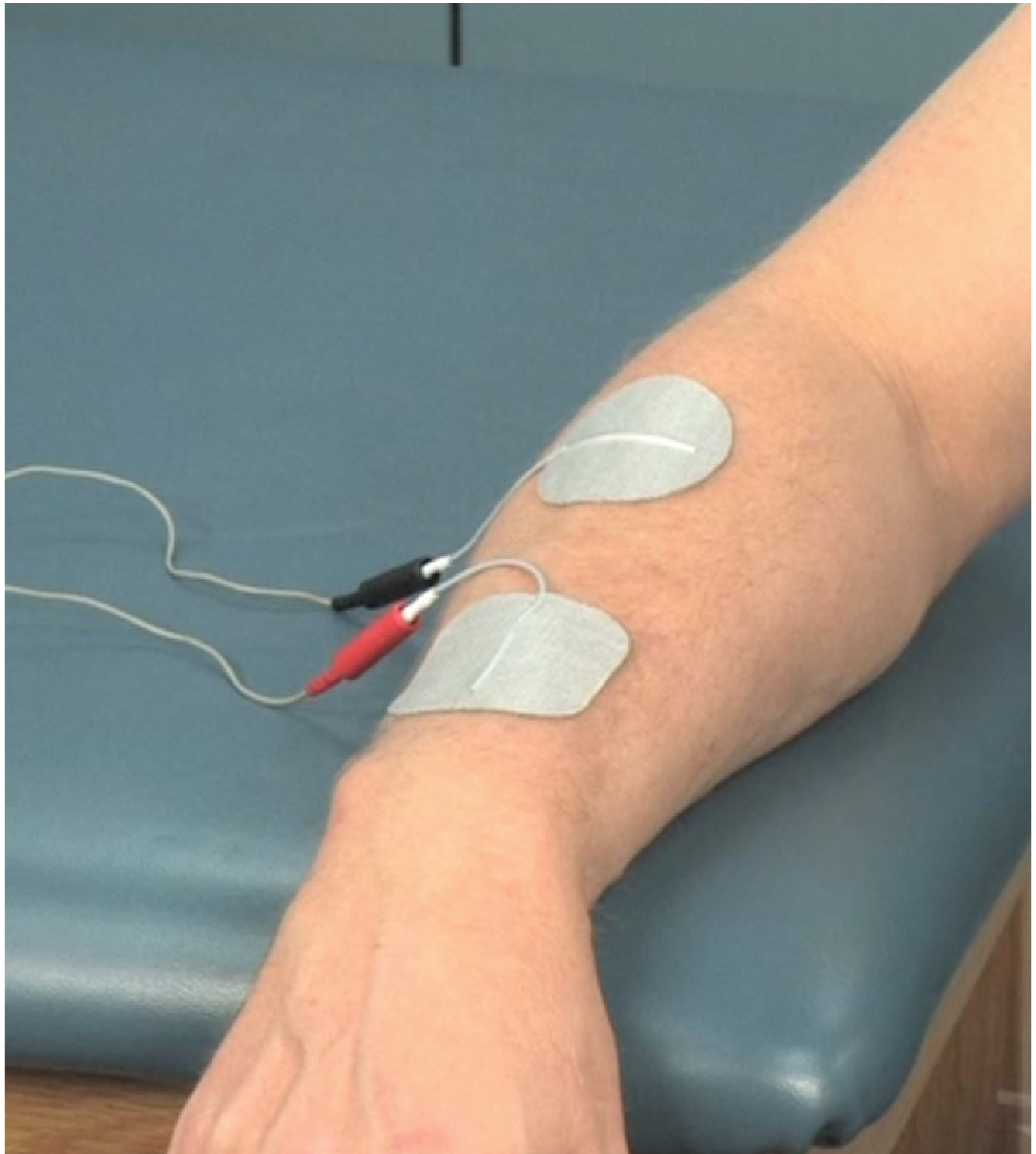
Sensors: EMG – Applications of EMG in Wearables

- EMG sensors in wearables can monitor muscle activity during physical activities.
- They can be used to track muscle fatigue, assess performance, and optimize workouts.
- In rehabilitation, EMG sensors help monitor muscle recovery and guide physical therapy.
- Assessing muscle function in patients with neurological disorders.
- Controlling prosthetic limbs using EMG signals from residual muscles.



Sensors: EMG – Challenges and Considerations

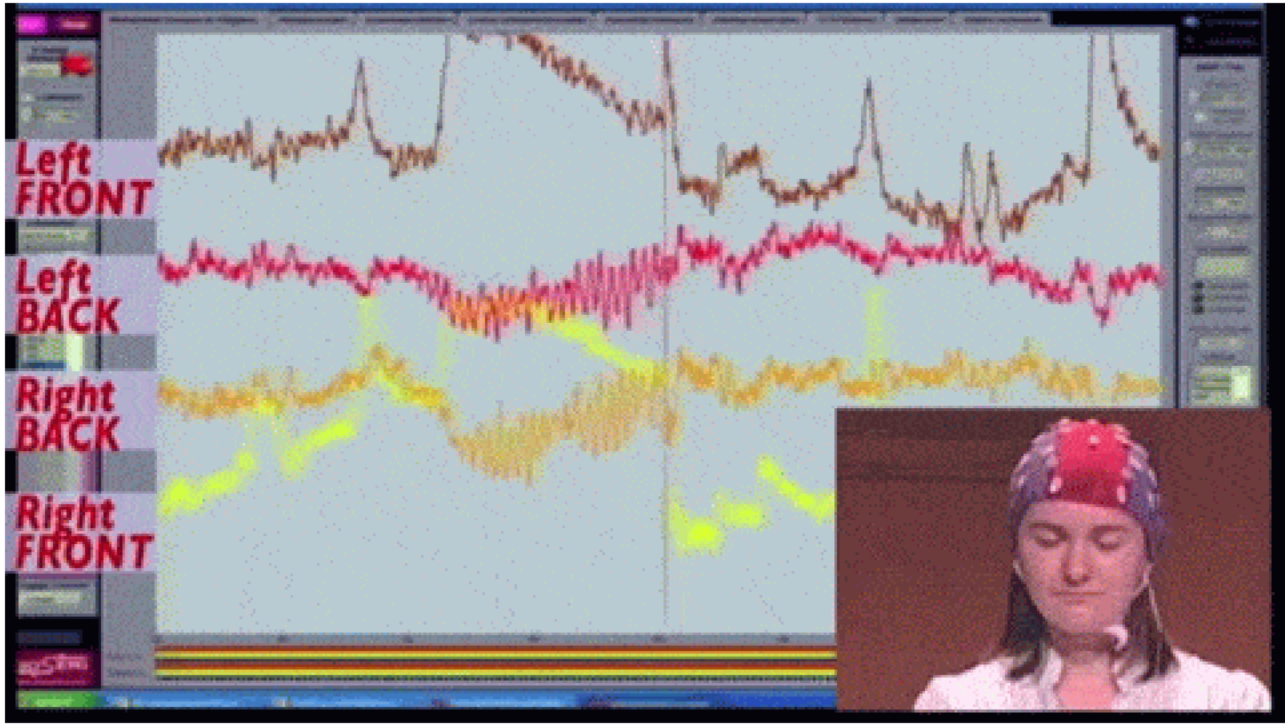
- Proper placement of electrodes is crucial for accurate signal detection.
- Signal interference from other muscles or electronic devices can affect readings.
- Calibration and signal processing algorithms are needed for reliable data interpretation.



Electroencephalography

Sensors: Electroencephalography

- EEG is a technique for recording the electrical activity of the brain.
- It measures voltage fluctuations resulting from ionic current flows within the neurons of the brain.
- EEG is commonly used in medical diagnostics, neurology, and cognitive neuroscience.



Sensors: How EEG Works

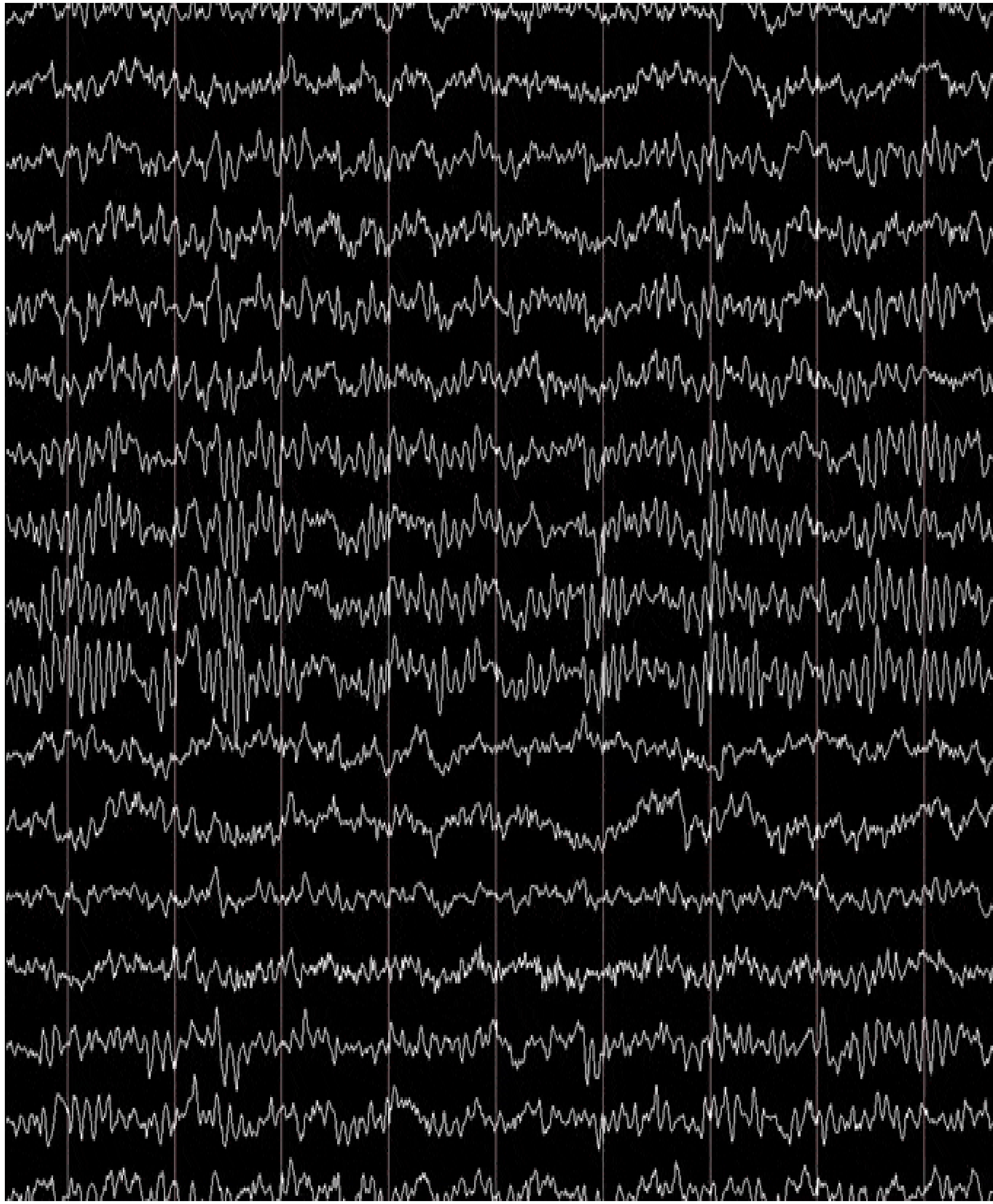
- EEG sensors consist of electrodes placed on the scalp to detect electrical signals.
- These signals represent the collective activity of millions of neurons in the brain.
- EEG recordings are analyzed to identify patterns associated with different brain states, such as sleep stages or cognitive tasks.

Sensors: Applications of EEG in Wearables

- Monitoring brain activity during sleep to analyze sleep quality and patterns.
- Brain-computer interfaces (BCIs) for controlling devices or interacting with virtual environments.
- Mental state monitoring for stress management, meditation guidance, and neurofeedback training.

Sensors: Challenges and Considerations

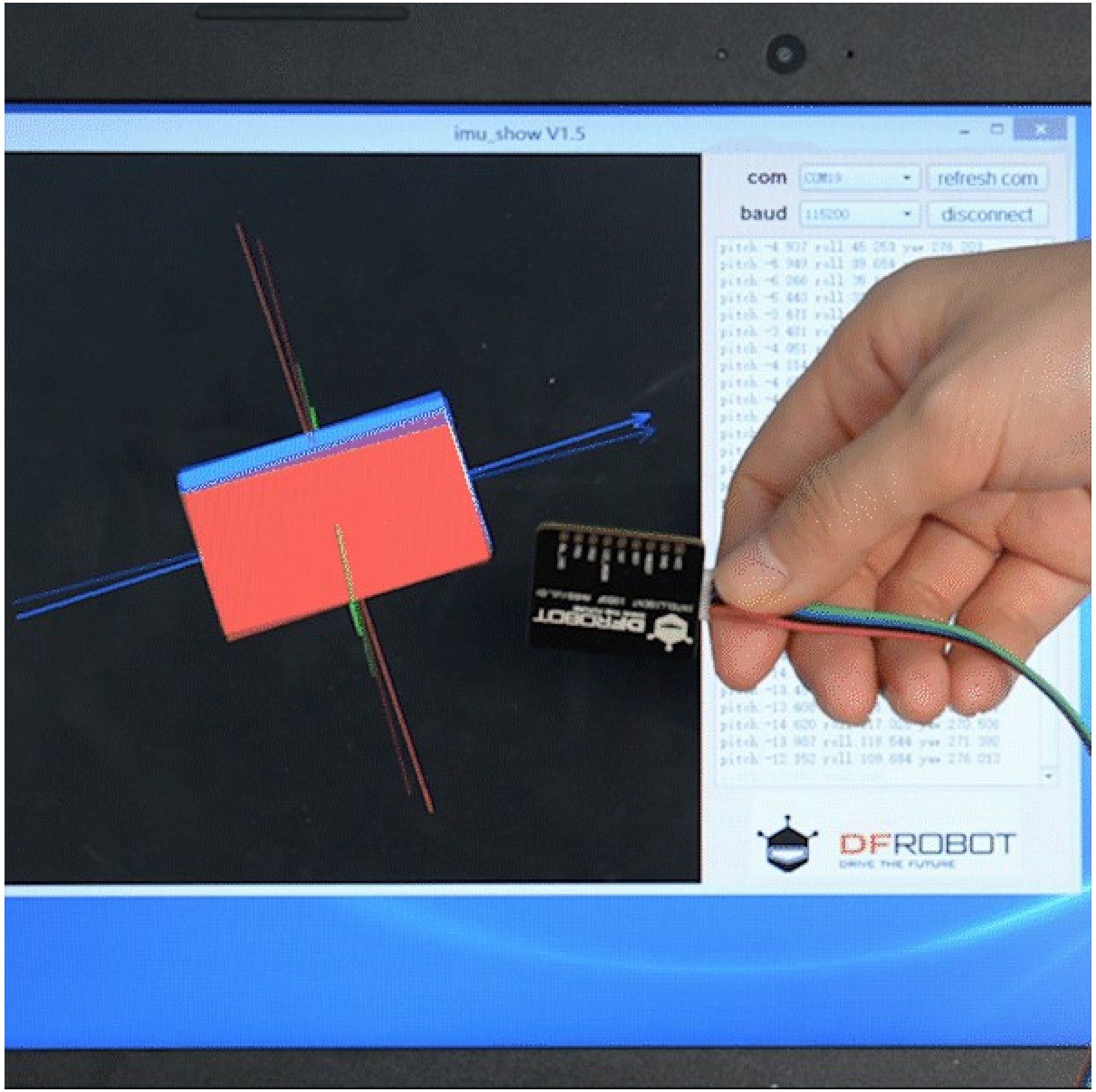
- Ensuring proper electrode placement and contact with the scalp for accurate recordings.
- Filtering EEG signals is a challenging process considering the reduced signal magnitude when compared to noise.
- Removing signal artifacts thar prevent proper analysis and feature identification. Artifacts such as muscle activity, eye movement, hear beat.



Motion Sensors

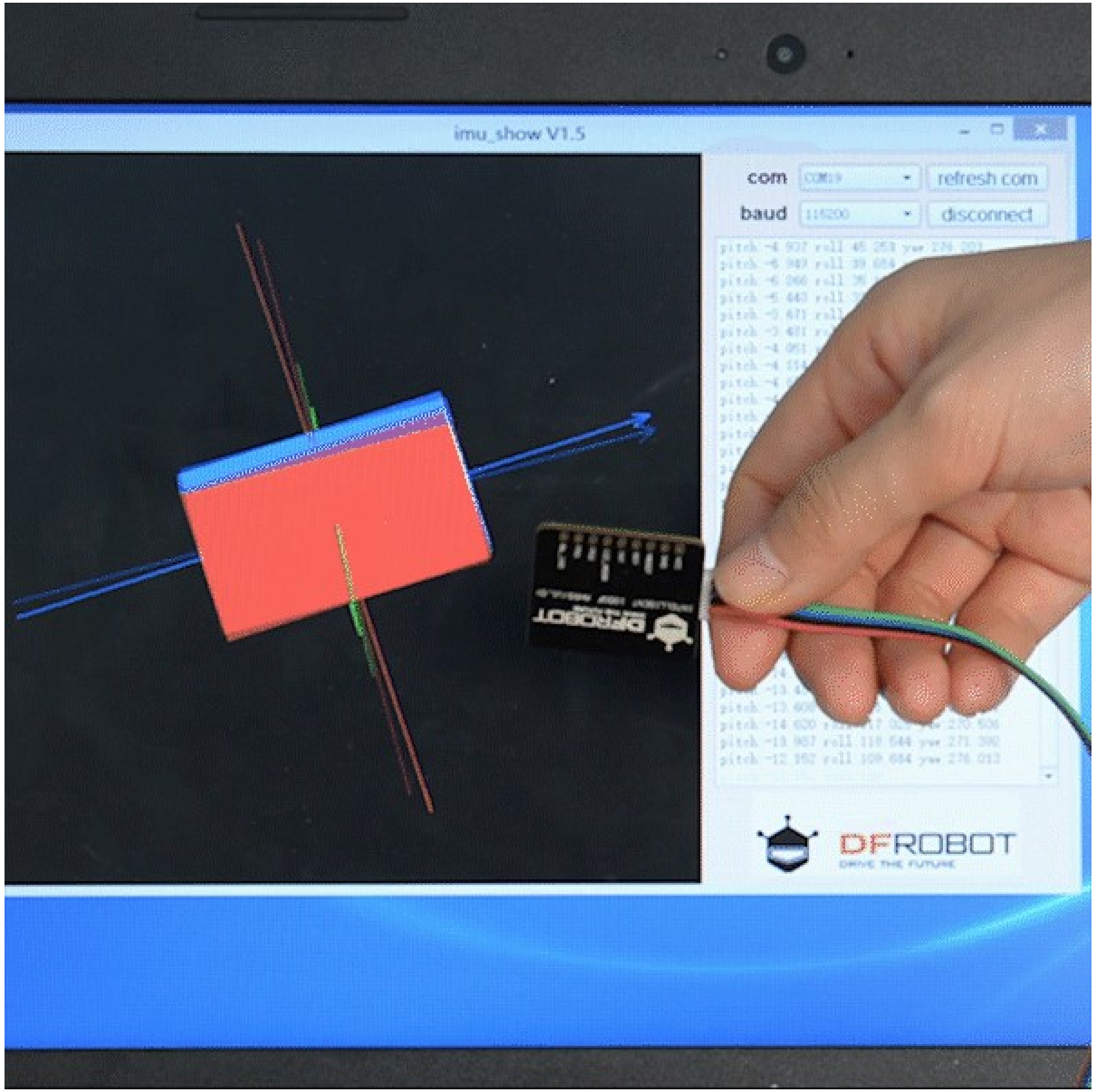
Sensors: Motion Sensors

- Motion sensors detect movement and orientation of objects or individuals.
- They are commonly used in wearable devices to track physical activities and gestures.
- Examples include accelerometers, gyroscopes, and magnetometers.



Sensors: Motion Sensors

- Accelerometers measure acceleration or change in velocity of the device.
- Gyroscopes detect angular velocity or rotation.
- Magnetometers measure the strength and direction of magnetic fields.

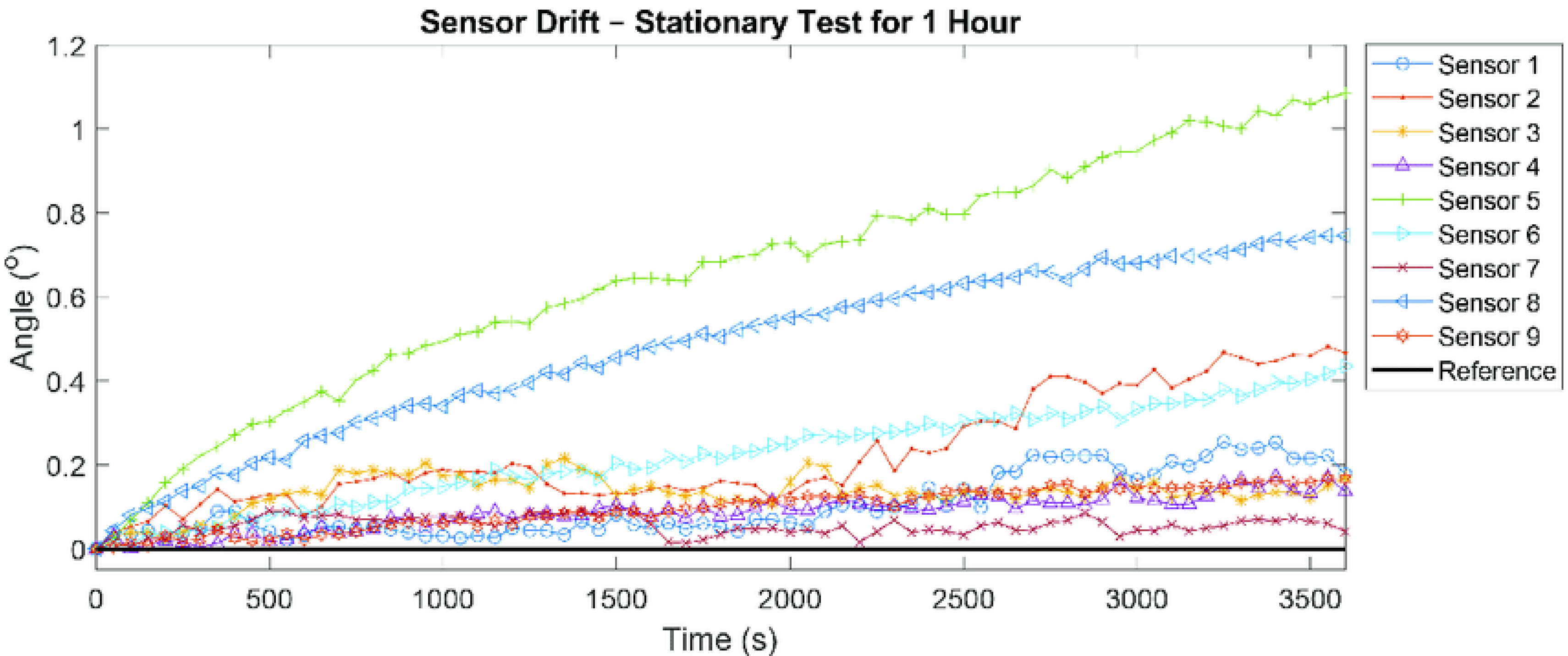


Applications of Motion Sensors in Wearables

- Monitoring physical activities such as walking, running, and cycling.
- Tracking gestures for user interface control in smart devices.
- Analyzing posture and movement patterns for sports performance or rehabilitation.

Motion Sensors: Challenges and Considerations

- Calibration and sensor fusion are essential for accurate motion tracking.
- Sensor drift can affect performance.
- Motion sensors may be sensitive to environmental factors such as temperature and magnetic interference.

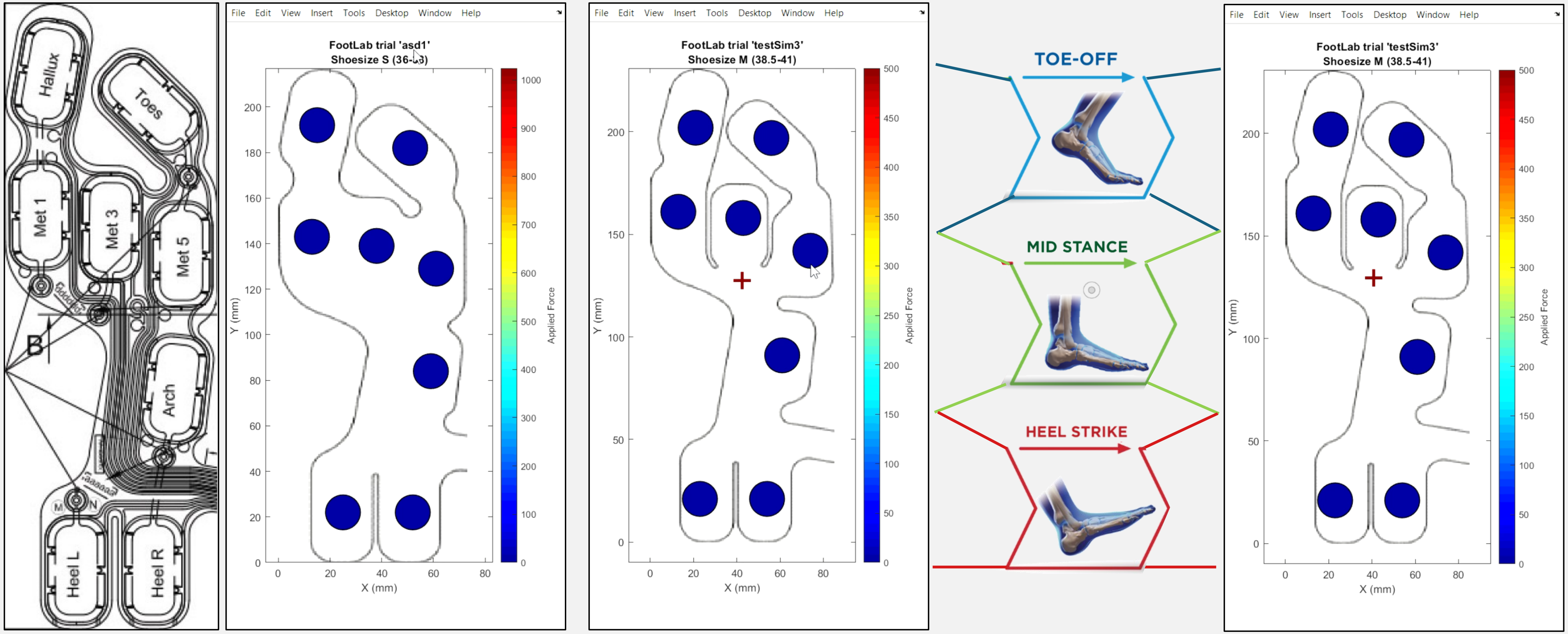


Pressure Sensors

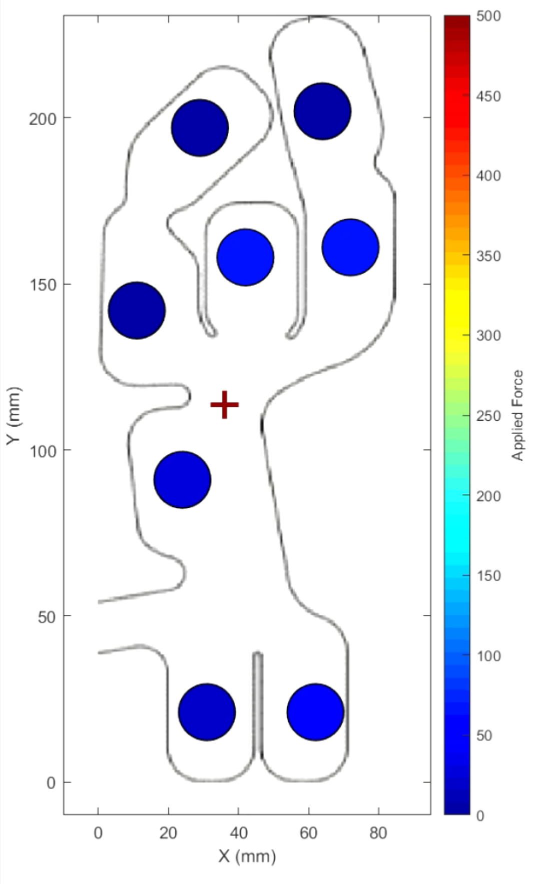
Pressure Sensors

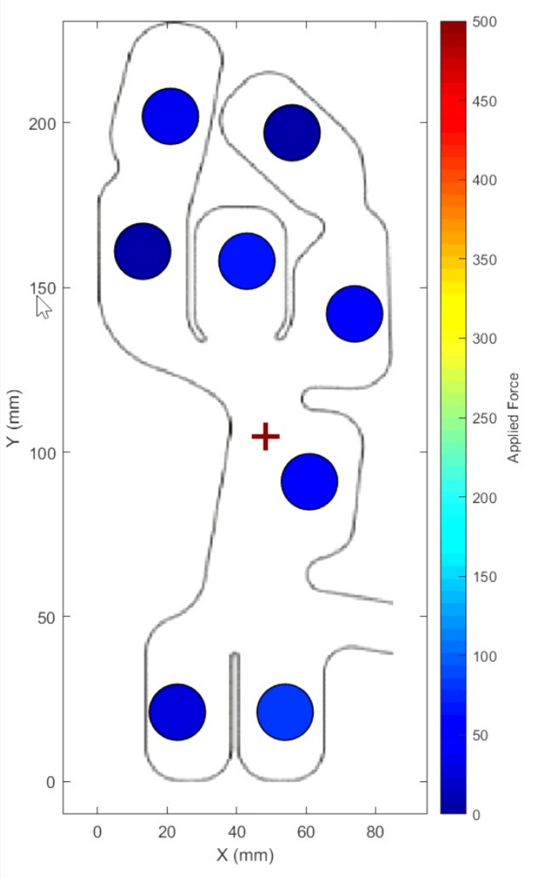
- Wearable pressure sensors consist of thin, flexible materials with embedded pressure-sensitive elements.
- When pressure is applied, the sensor deforms, changing its electrical resistance, capacitance, or other properties.
- Electronics connected to the sensor convert these changes into digital signals for analysis.

Smart Insole Acquisition



Smart Insole Acquisition






eDYNAMICS


1 Injury
a match
21% of injuries
are recurrent

Motion & Force Sensors

MSK Health Analysis

IoT Device

Team Monitoring

Versatile Design

Fitting Any Shoe

MSK Models

MSK Biomarkers Analysis

Posture Imbalance | Peak Force
Force Asymmetry | Fatigue

Data-driven AI Model

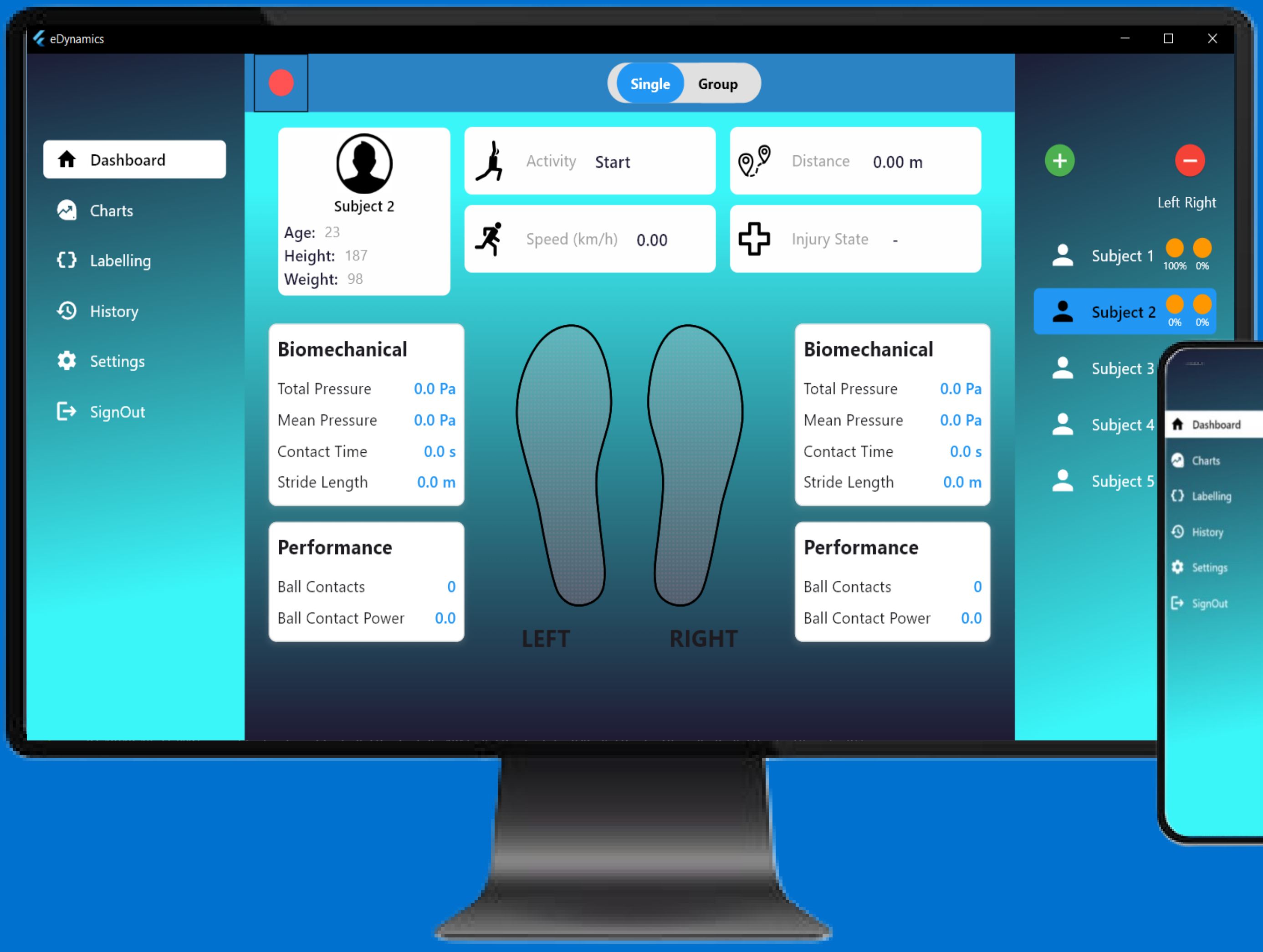
Personalized Prediction of Injury Risk

eSole

Validated against Laboratory Systems

Cloud-based Cross-Platform Dashboard

Occupational Health & Manager Staff

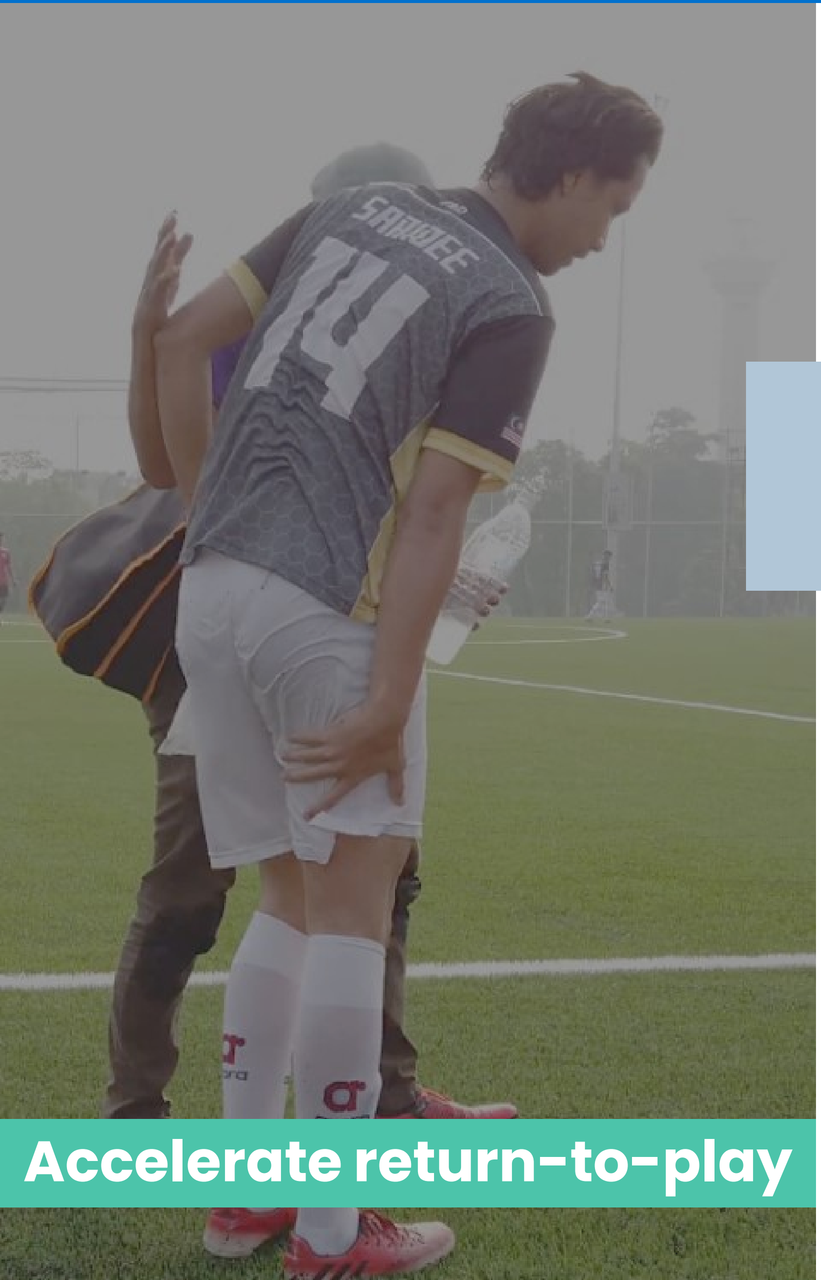


Highly-detailed Fatigue Analysis of a Group of Workers Anytime, Anywhere

Foot-Ground Interaction

Foot-Ball Interaction

Unique Selling Proposition



Accelerate return-to-play

Non-intrusive HealthTech enabling:

DECISION SUPPORT TOOL for medical and technical staff for entire teams

Injury Preventive Care

Use cases


Professional Sports
Occupational Health
Recovery / Training
In-Labor

eDYNAMICS

Empower Human Motor Dynamics

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eSole is a game-changer