Guilherme Ramos | Research Software Engineer

A Guided Exploration through Signal Acquisition and Processing

with...

biosignalsplux

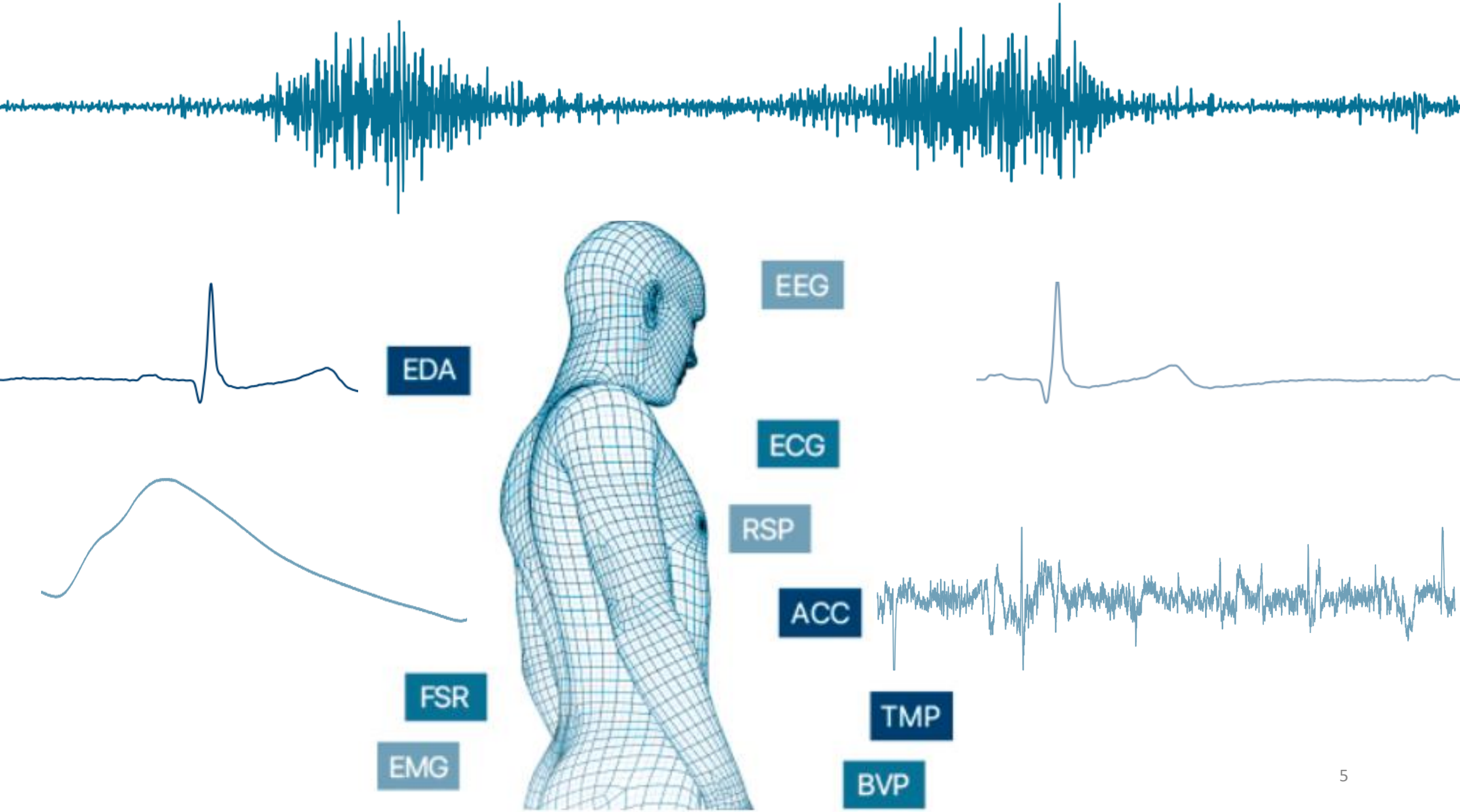
wearable body sensing platform

and

biosignals notebooks

Presentation Agenda

A. **A Brief Intro about Physiological Signals**
B. **biosignalsplux**
   a) *Description of the Device*
   b) *Available Sensors*
   c) *Synchronization Process*
   d) *Purchase Options*
C. **OpenSignals**
   a) *Demonstration of Real-Time Signal Acquisition*
   b) *Software Main Functionalities*
D. **Additional Resources (Signal Samples)**
E. **Biosignalsnotebooks**
   a) *Project Intro*
   b) *A Guide through Notebooks*
   c) *Challenge to the audience*


EEG
EDA
ECG
RSP
ACC
FSR
TMP
EMG
BVP

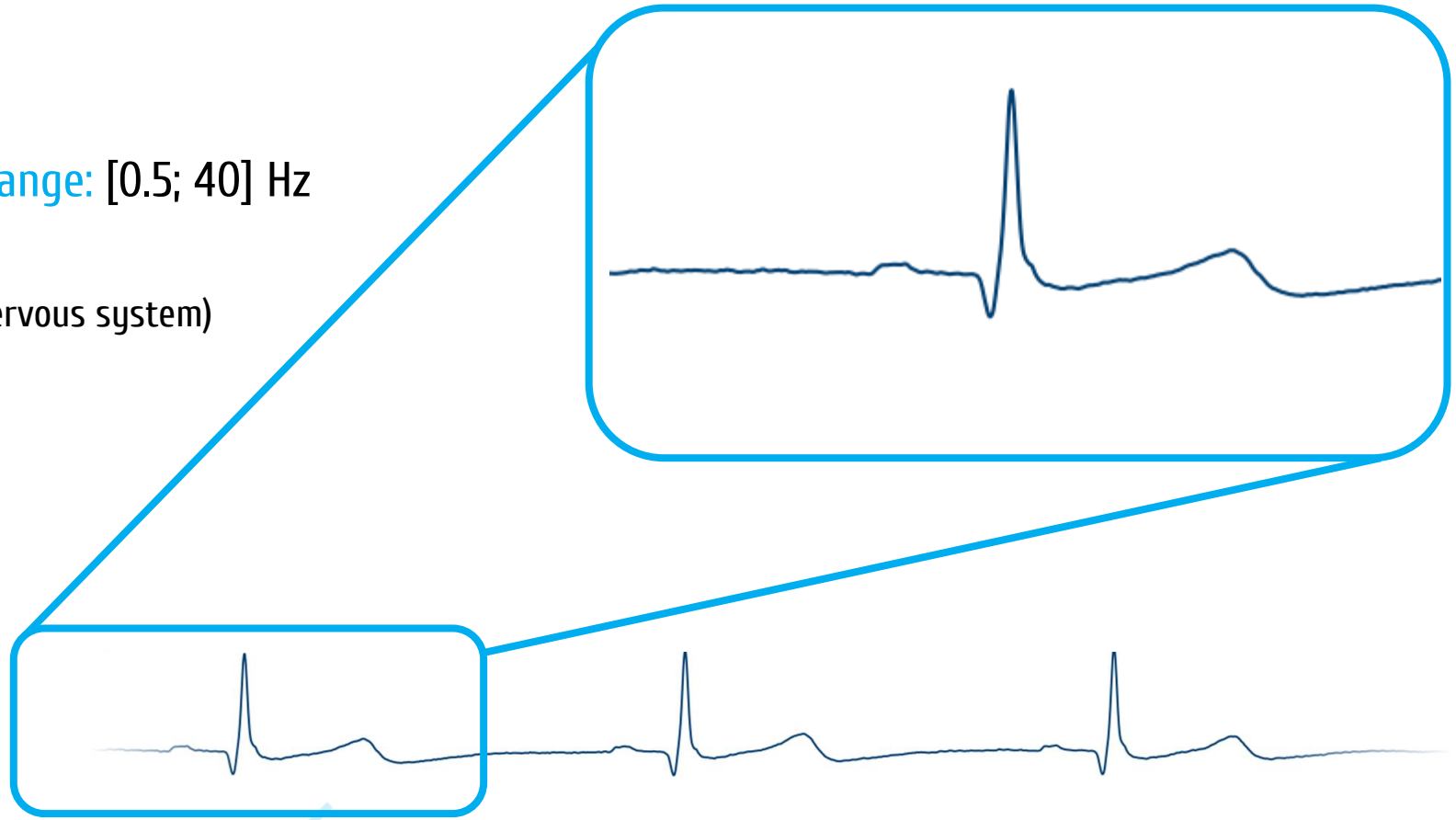
Physiological Signals – Examples

- **Electrocardiographic Signal (ECG)**
  - Characteristics

    Periodic

    Frequency Range: [0.5; 40] Hz

    Involuntary
    (modulated by autonomic nervous system)



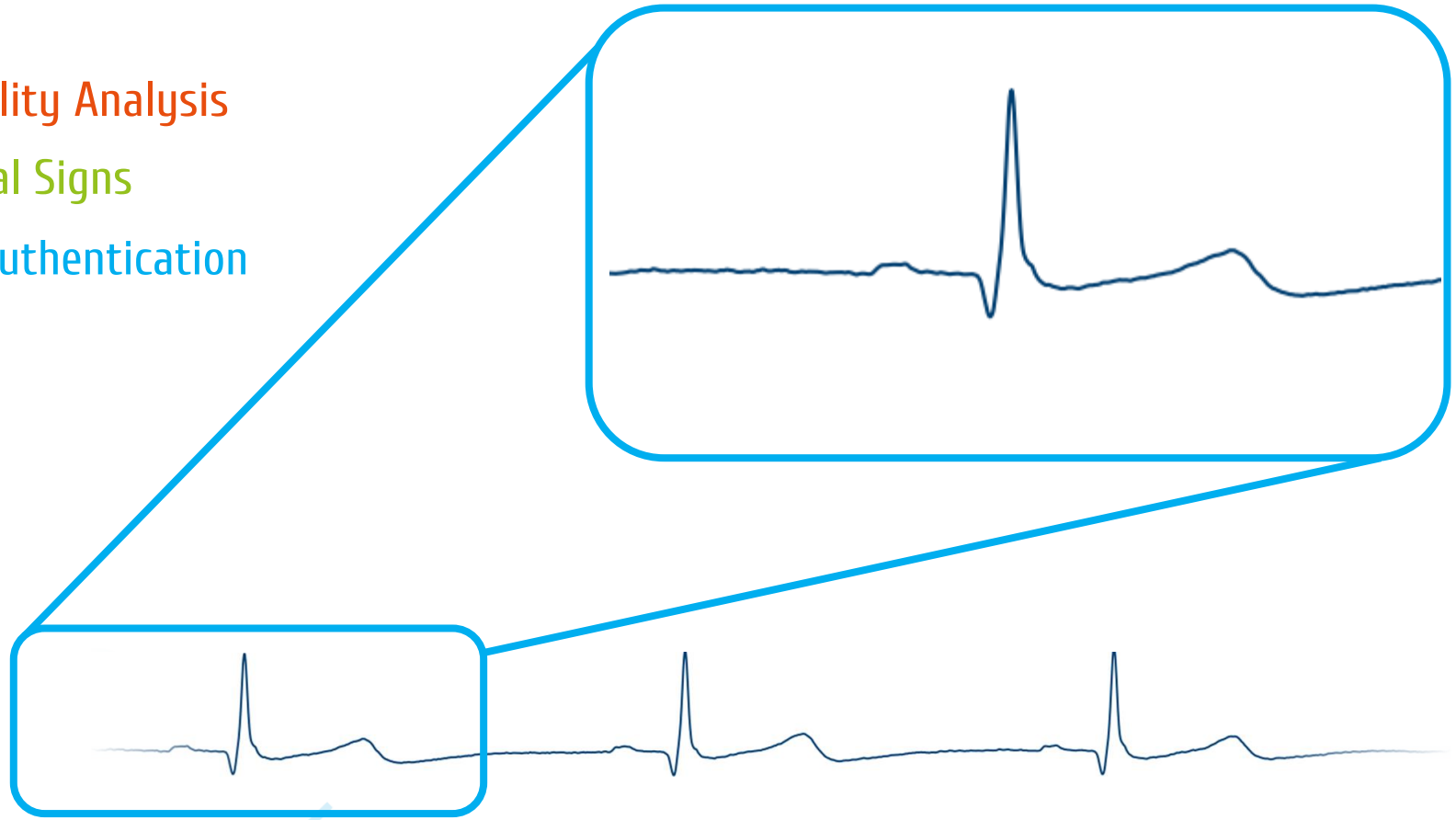
Physiological Signals - Examples

- **Electrocardiographic Signal (ECG)**
  - Applications

Heart Rate Variability Analysis

Monitorization of Vital Signs

Biometric Authentication



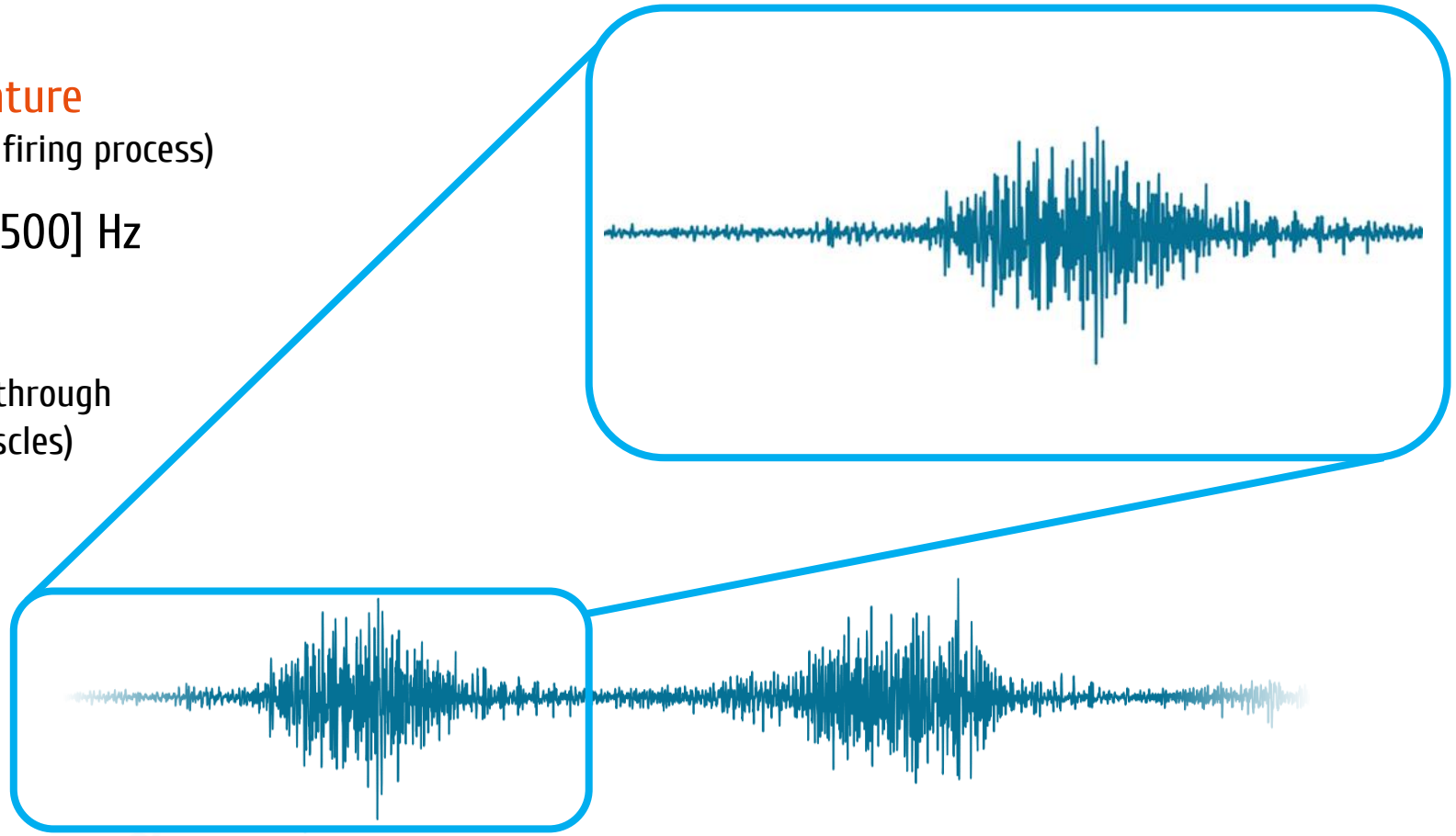
Physiological Signals – Examples

- **Electromyographic Signal (EMG)**
  - Characteristics

    Partial Random Nature
    (Due to the motor unit firing process)

    Frequency Range: [25; 500] Hz

Voluntary Origin
(Neuronal impulse transmission through motor neurons connected to muscles)



Physiological Signals - Examples

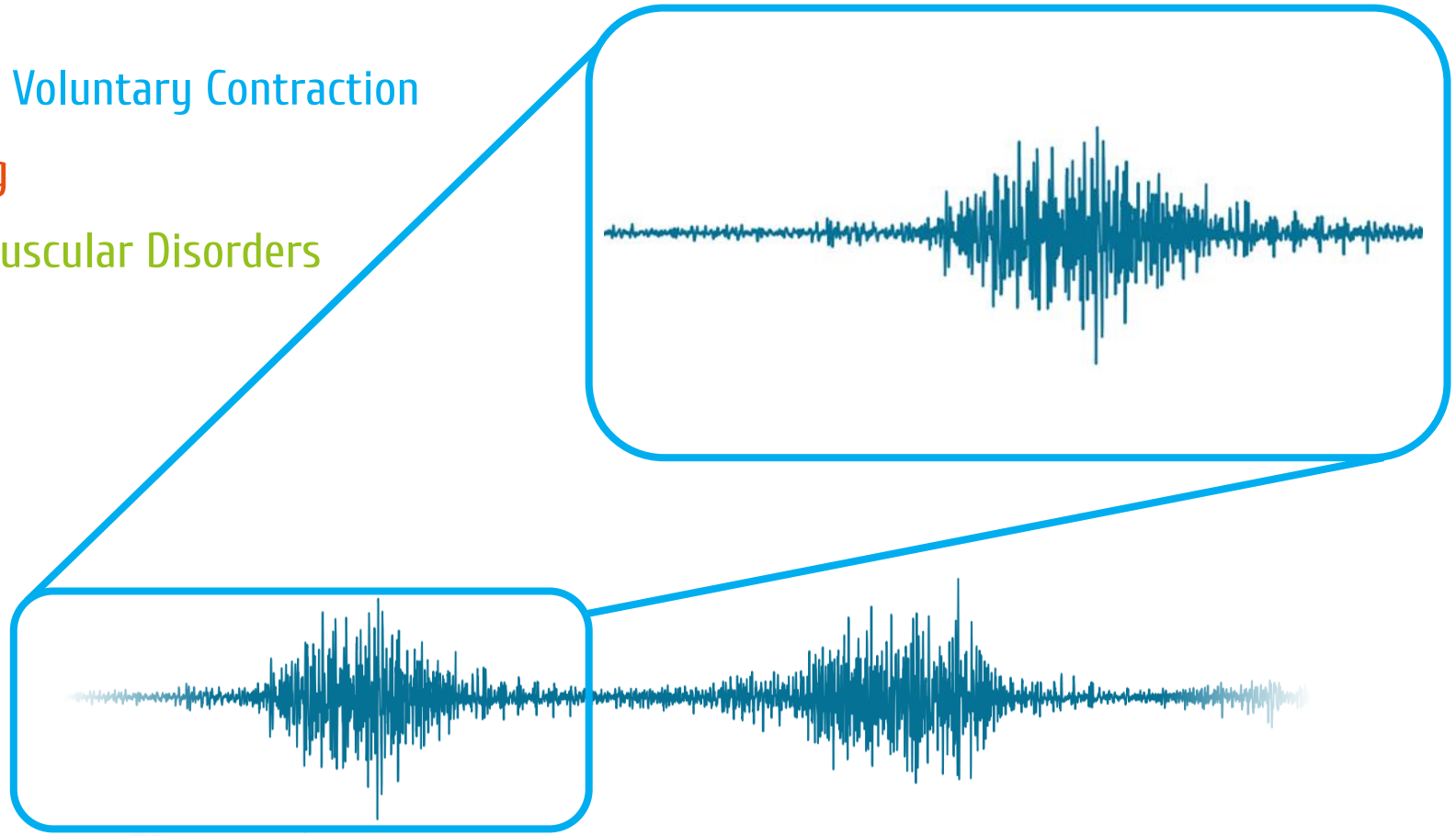
- **Electromyographic Signal (EMG)**
  - Applications

    Analysis of Maximum Voluntary Contraction

    Fatigue Monitoring

    Diagnosis of Neuromuscular Disorders

    Interactive Gamming



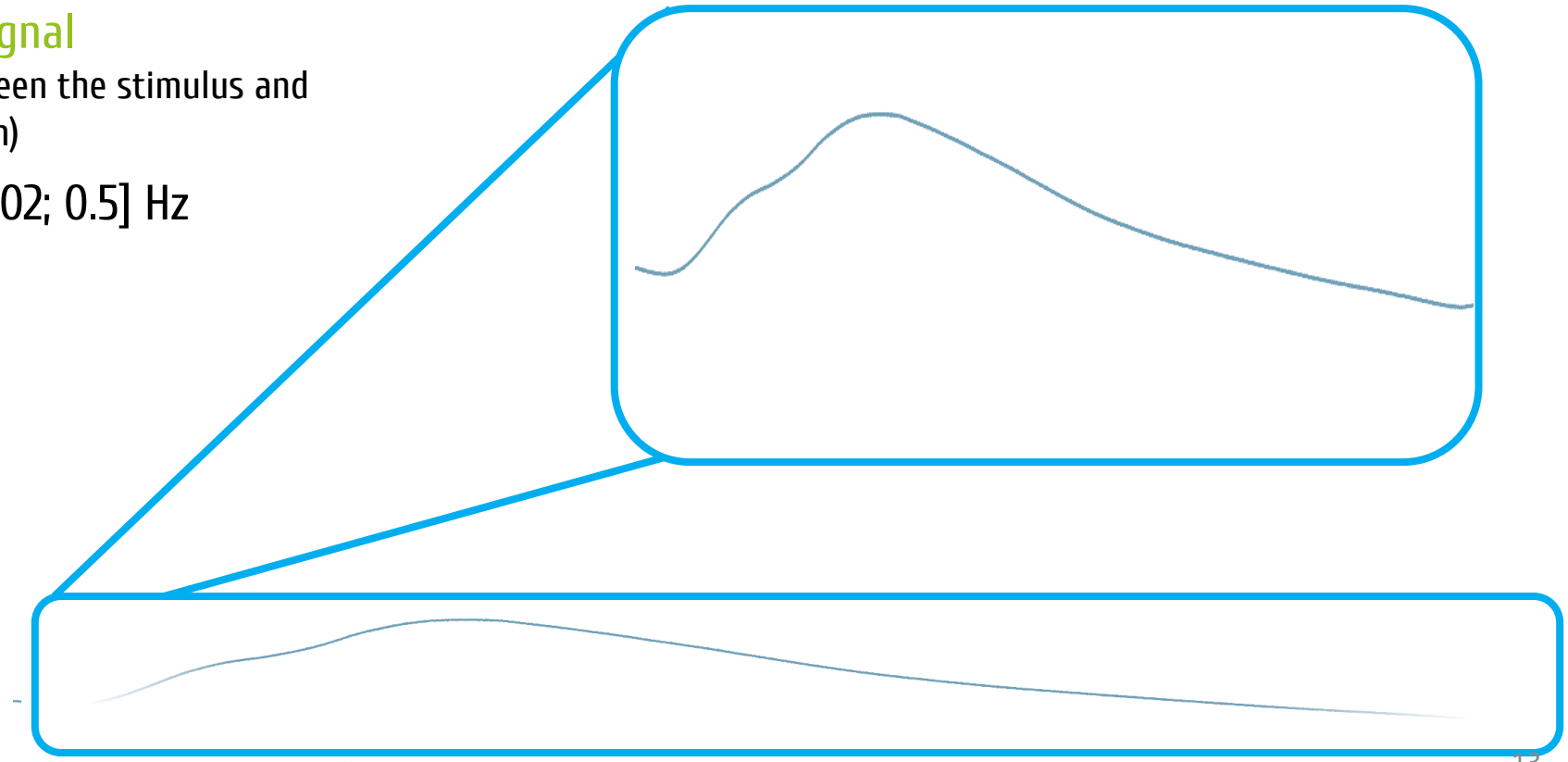
Physiological Signals - Examples

- **Electrodermal Activity (EDA)**
  - Characteristics

    Delayed Response Signal
    (There is a small lag between the stimulus and the electrodermal reaction)

    Frequency Range: [0.02; 0.5] Hz

    Involuntary Origin
    (Sympathetic modulation)



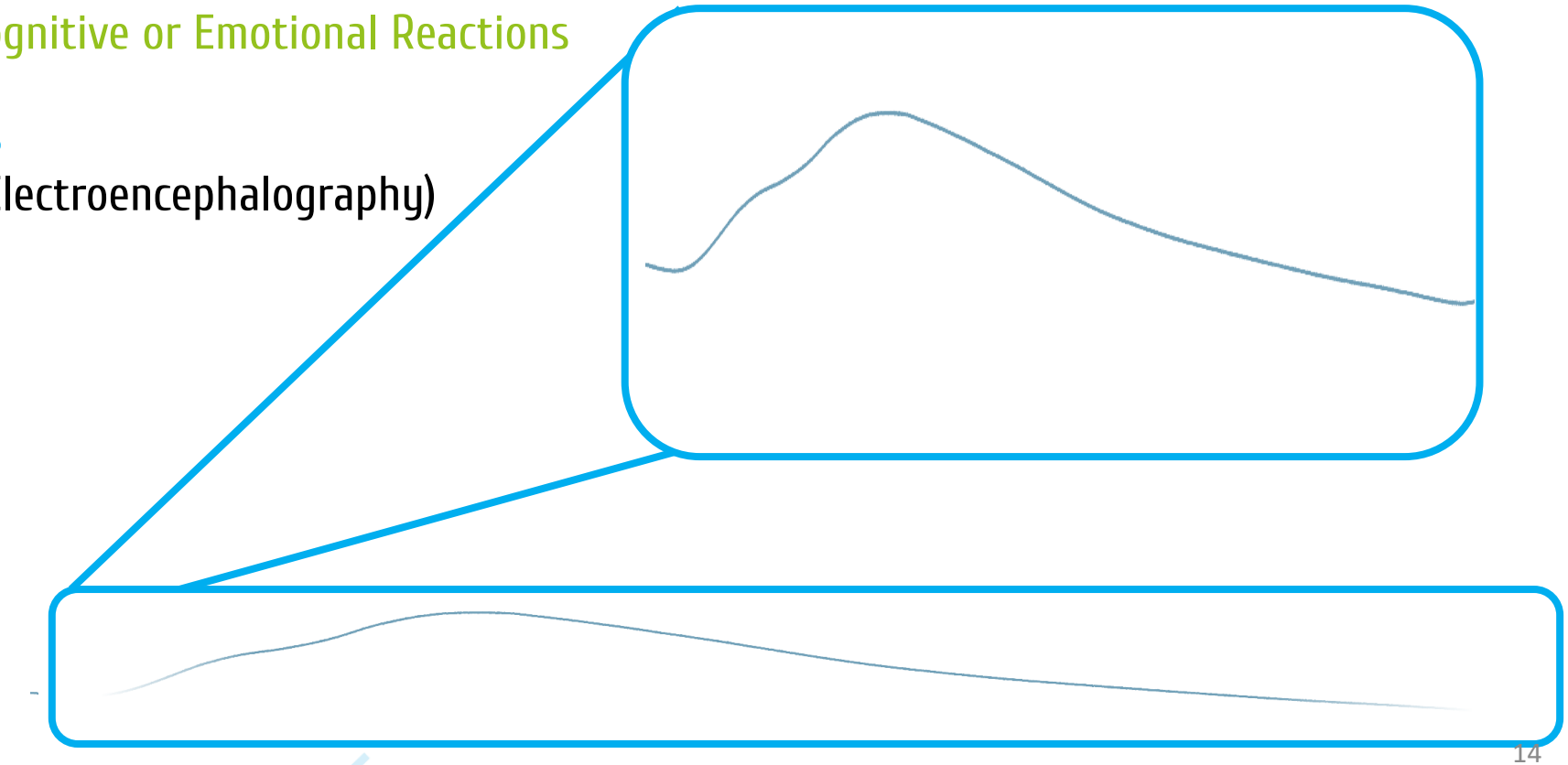
Physiological Signals - Examples

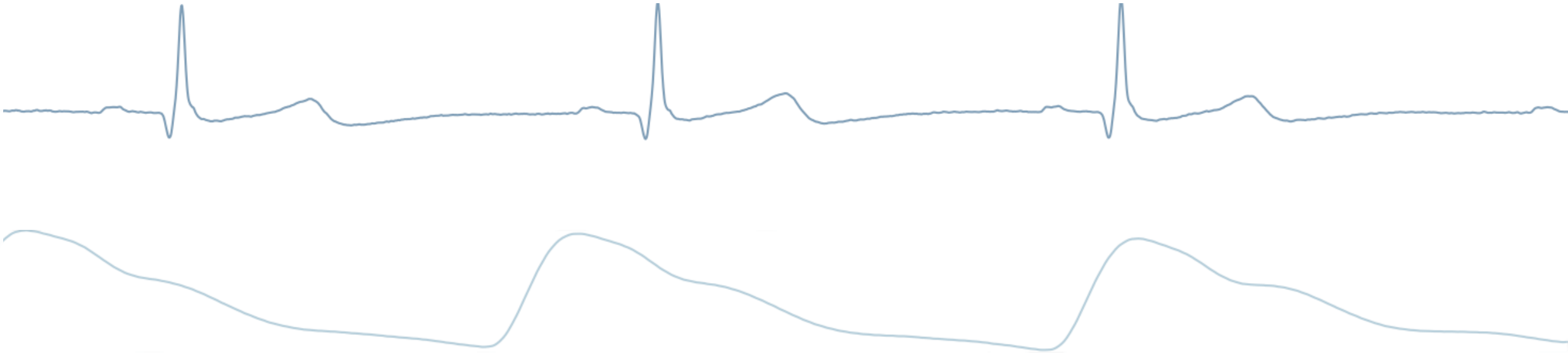
- **Electrodermal Activity (EDA)**
  - Applications

    Monitorization of Cognitive or Emotional Reactions

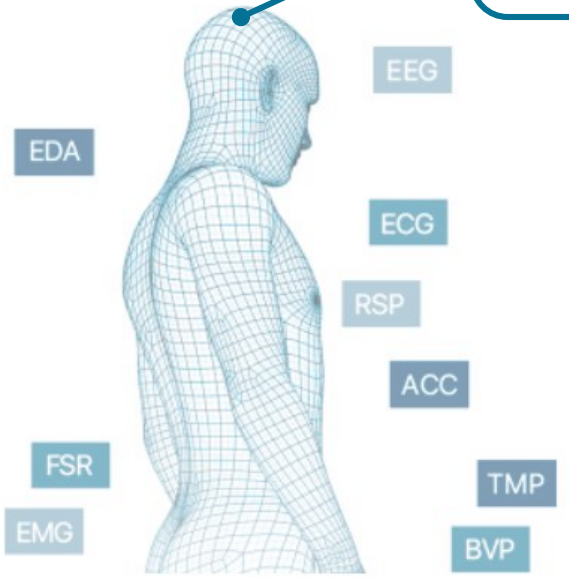
    Neurological Status

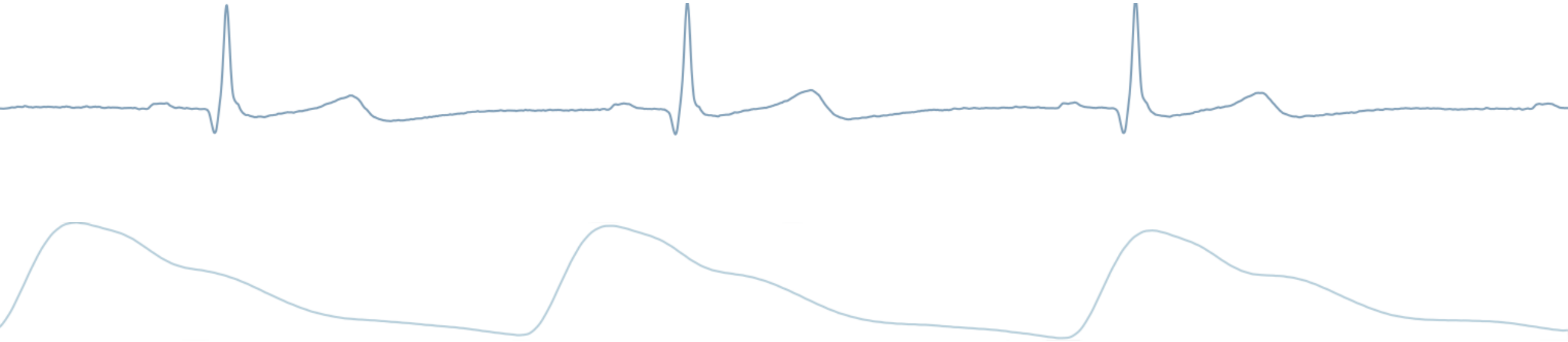
    (An alternative to Electroencephalography)





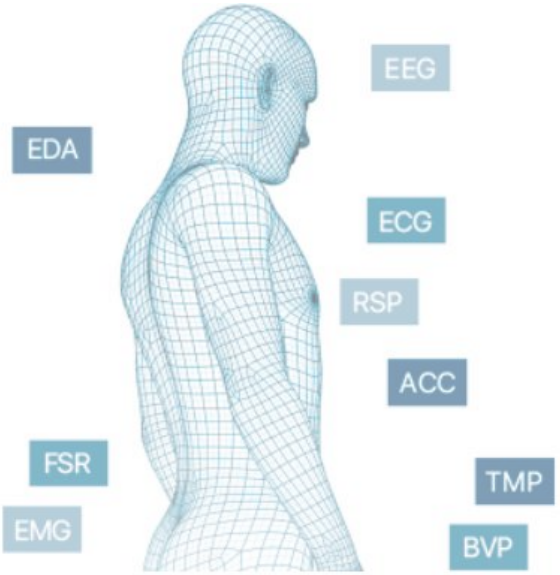
It would be extremely interesting if we have an unified system where all this signals can be acquired together...
Wouldn't be ?

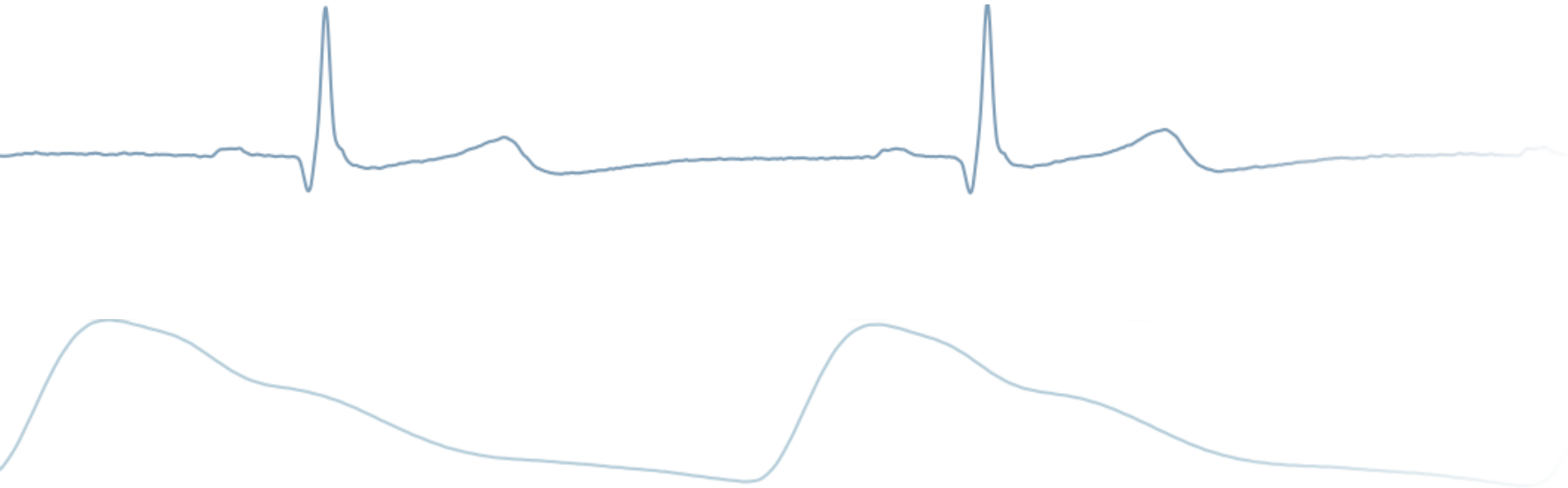


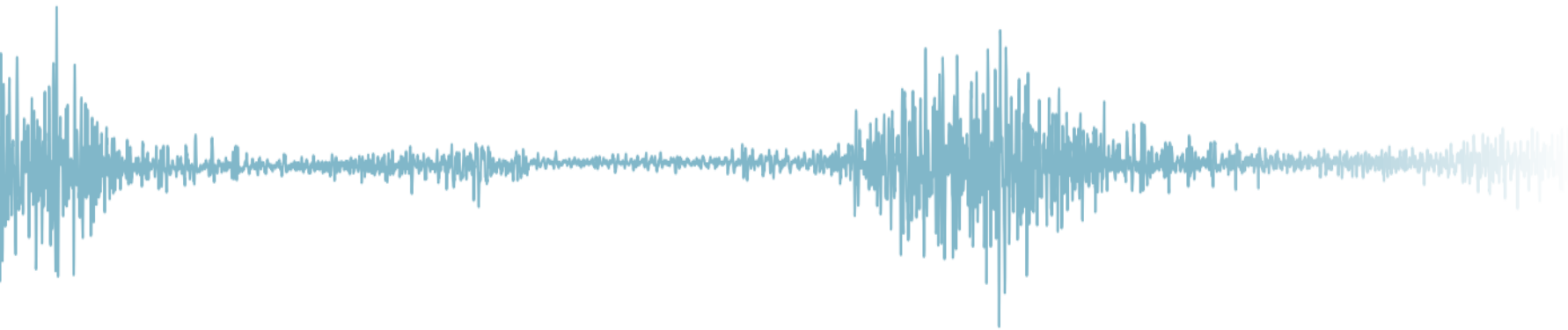


biosignalsplux

wearable body sensing platform







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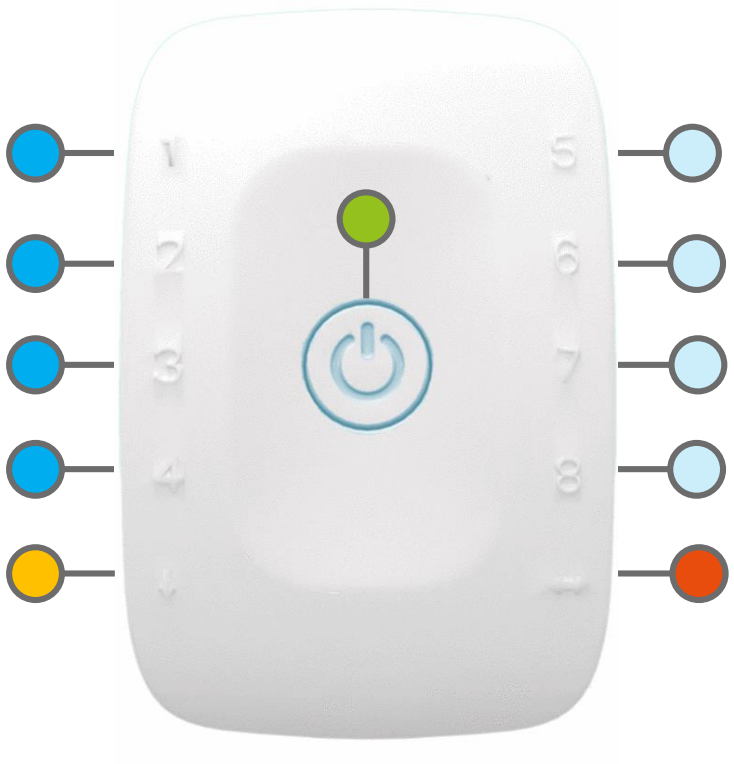
wearable body sensing platform

biosignalsplux Hub



- 4 Analog Channels/Inputs
- 4 Additional Analog Channels/Inputs
- Power Button
- Reference/Ground Port [Digital Channel]
- Digital Port [Sync Functionality]

Acquisition Parameters:

ADC configurable resolution between 8 and 16 bits

Sampling rates up to 4000 Hz

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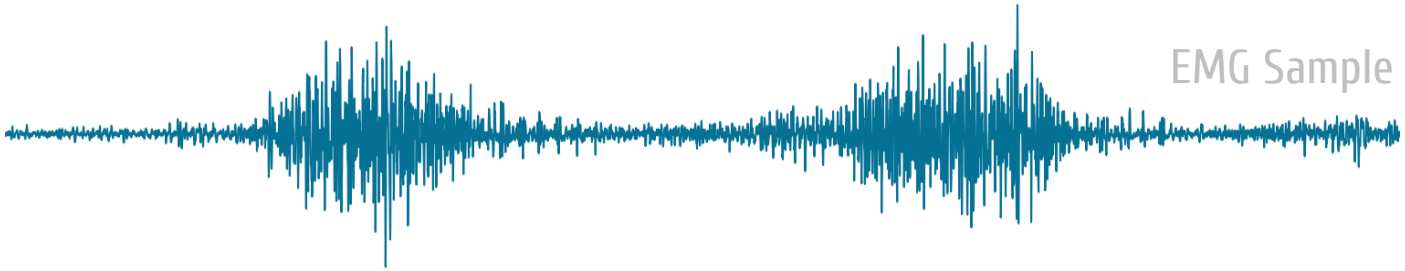
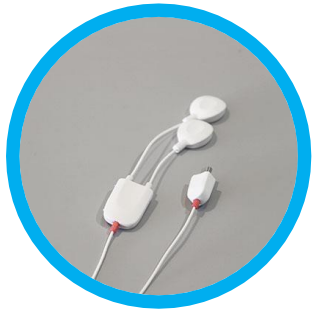
wearable body sensing platform



biosignalsplux Sensors



Electromyography (EMG)

Electrodermal Activity (EDA)

Electrocardiography (ECG)

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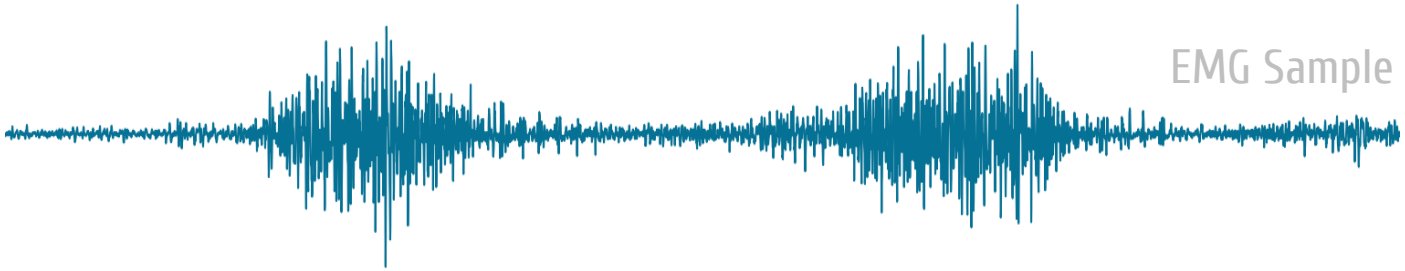
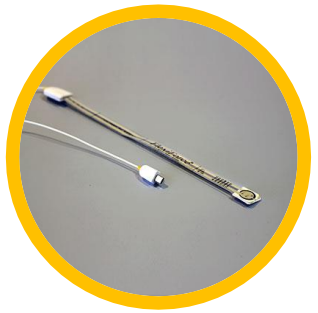


biosignalsplux Sensors

Electroencephalography (EEG)

Accelerometer (ACC)

Respiration (PZT)



Force Sensor (FSR)

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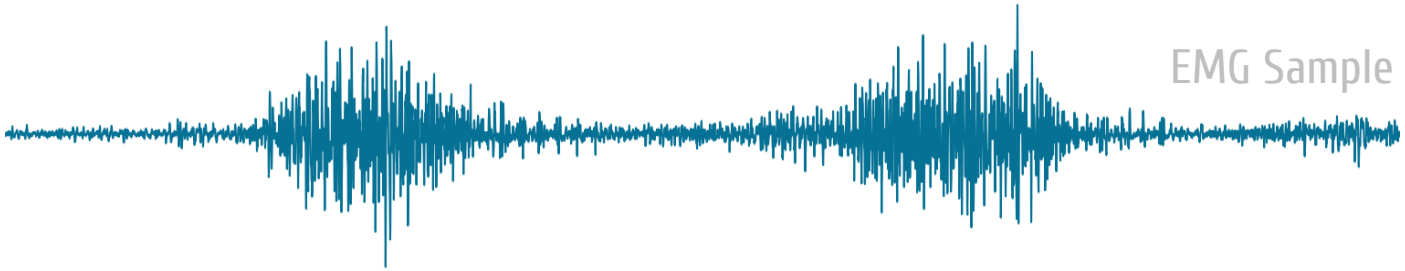
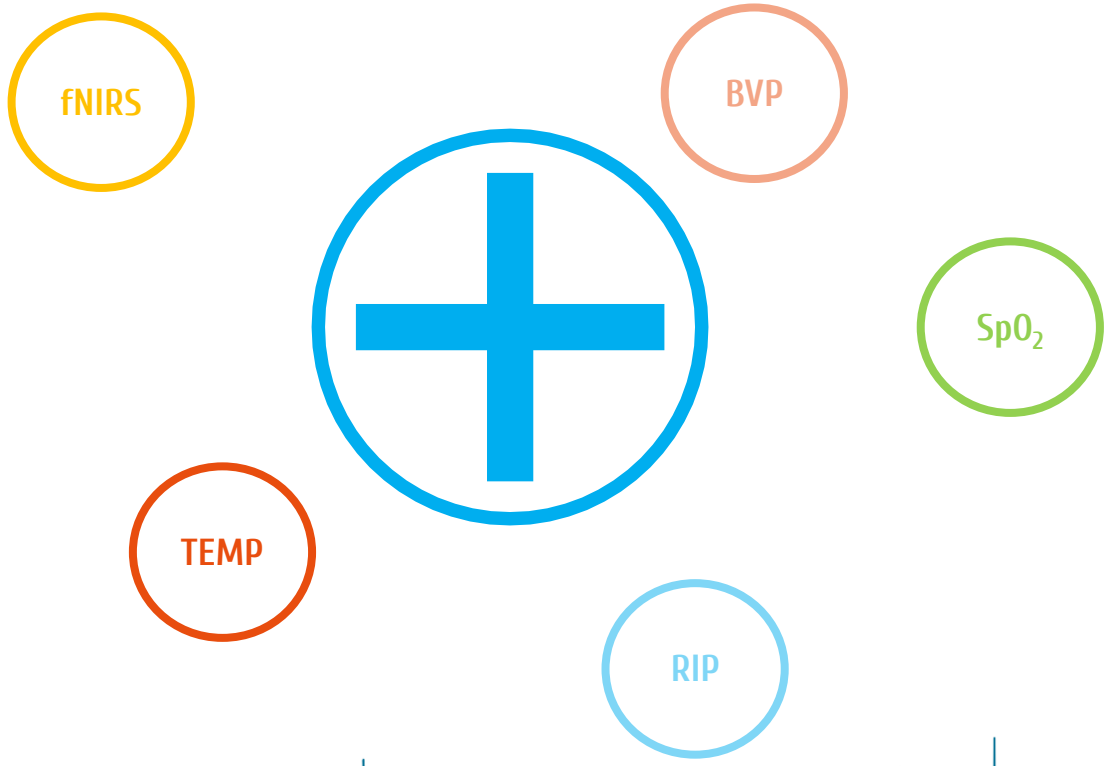
wearable body sensing platform



biosignalsplux Sensors



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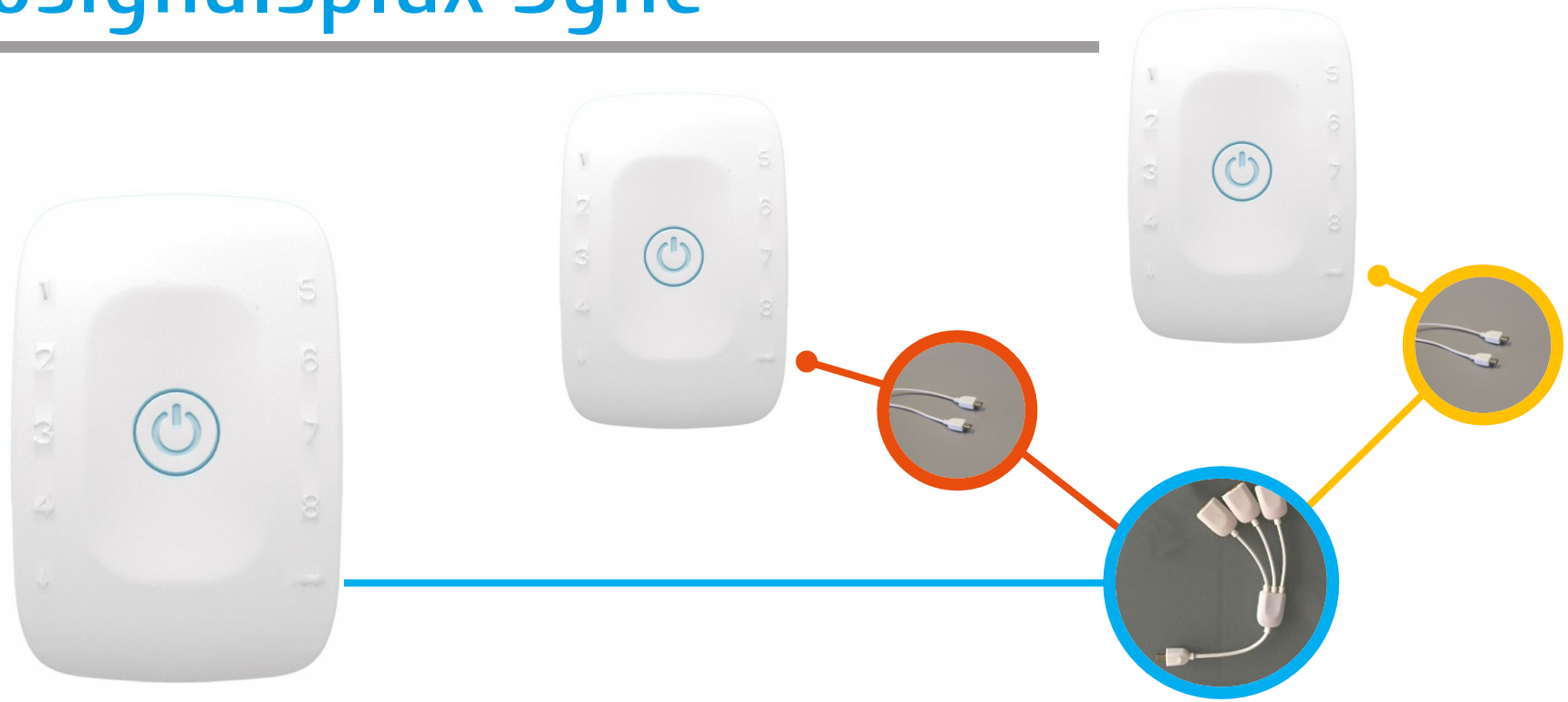
biosignalsplux Sync



Multi Sync Splitter

Up to 24 Channels

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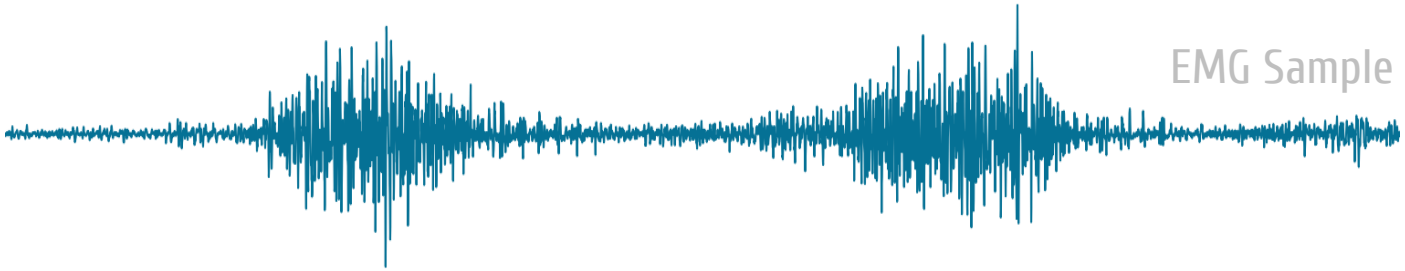
wearable body sensing platform

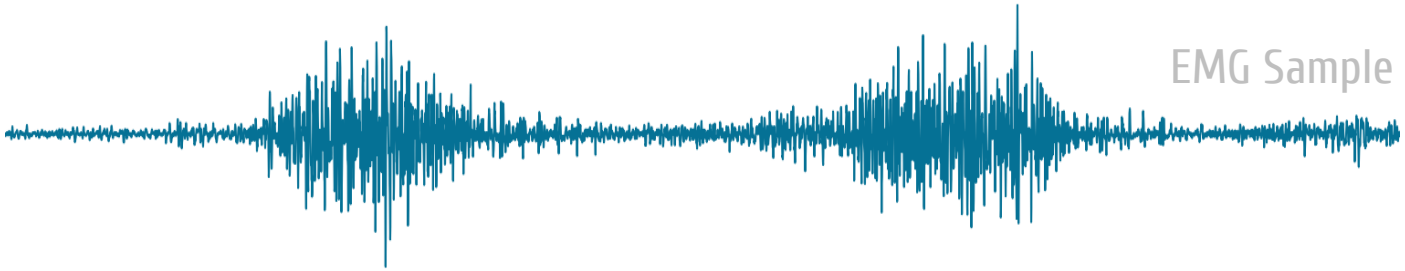


biosignalsplux - Options

biosignalsplux Explorer

The package includes:

- 1 x Wireless 4-channel hub;
- 4 x Professional sensors (you choose)
- 24 x Pre-gelled electrodes
- 1 x Bluetooth dongle
- 1 x Medical-grade charger
- 1 x Portable and rugged storage case with foam cushioning to house all the parts



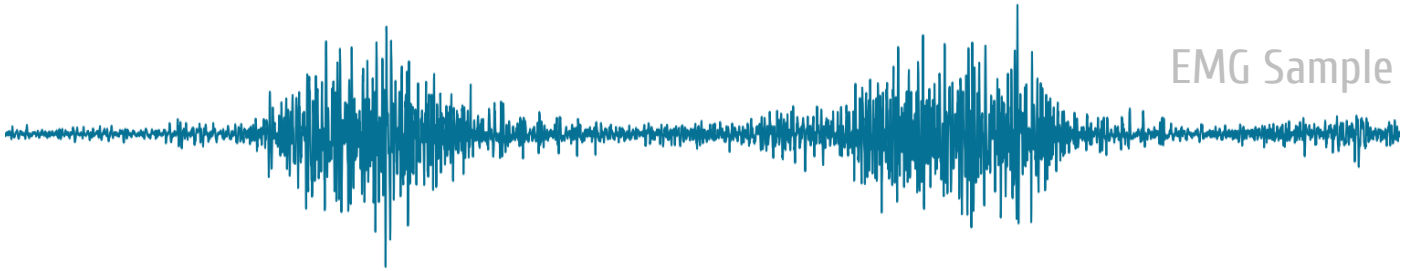
biosignalsplux - Options

biosignalsplux Researcher

The package includes:

- 1 x Wireless 8-channel hub
- 8 x Professional sensors (you choose)
- 24 x Pre-gelled electrodes
- 1 x Bluetooth dongle
- 1 x Medical-grade charger
- 1 x Portable and rugged storage case
- 8 h Personalised technical support
- Xtra Care - 1 year service and maintenance agreement

biosignalsplux
wearable body sensing platform



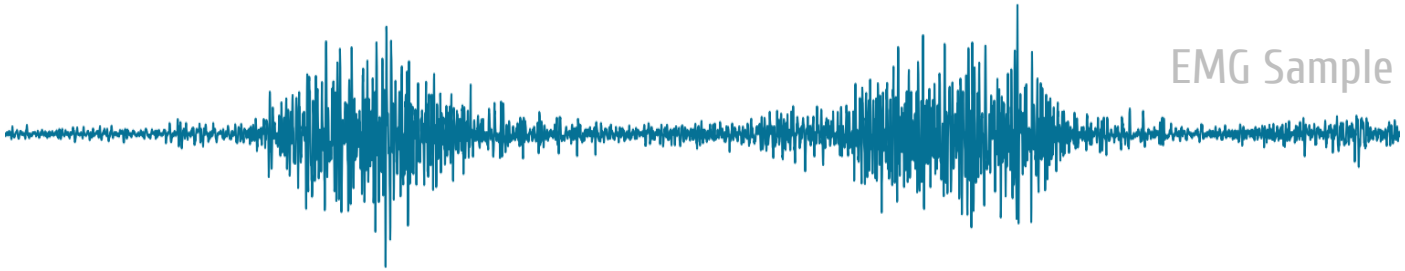
biosignalsplux - Options

biosignalsplux Professional

The package includes:

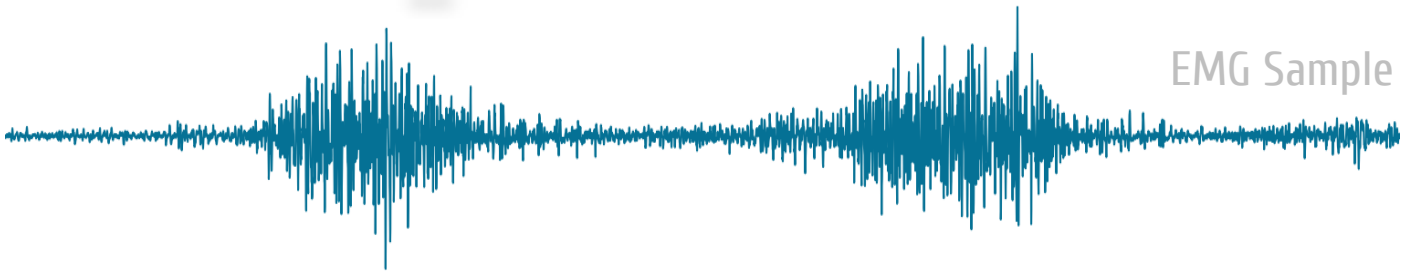
- 1 x Wireless 8-channel hub
- 8 x Professional sensors (you choose)
- 1 x Synchronization Kit (SYNC)
- 24 x Pre-gelled electrodes
- 1 x Bluetooth dongle
- 1 x Medical-grade charger
- 1 x Portable and rugged storage case
- 16 h Personalised technical support
- Xtra Care - 2 years service and maintenance agreement
- 1x Fast USB data transfer cable

biosignalsplux
wearable body sensing platform




opensignals

biosignalsplux API List



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wearable body sensing platform

Signal Samples

Technical Notes

Synched Videos

https://www.biosignalsplux.com/en/learn/signal-samples

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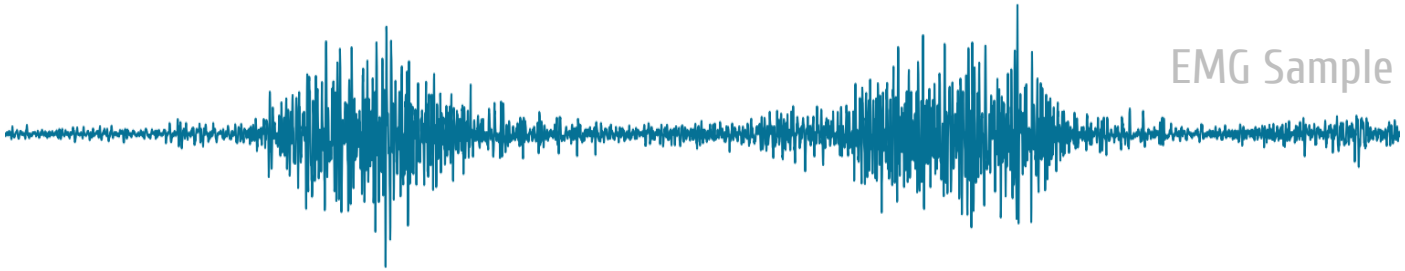
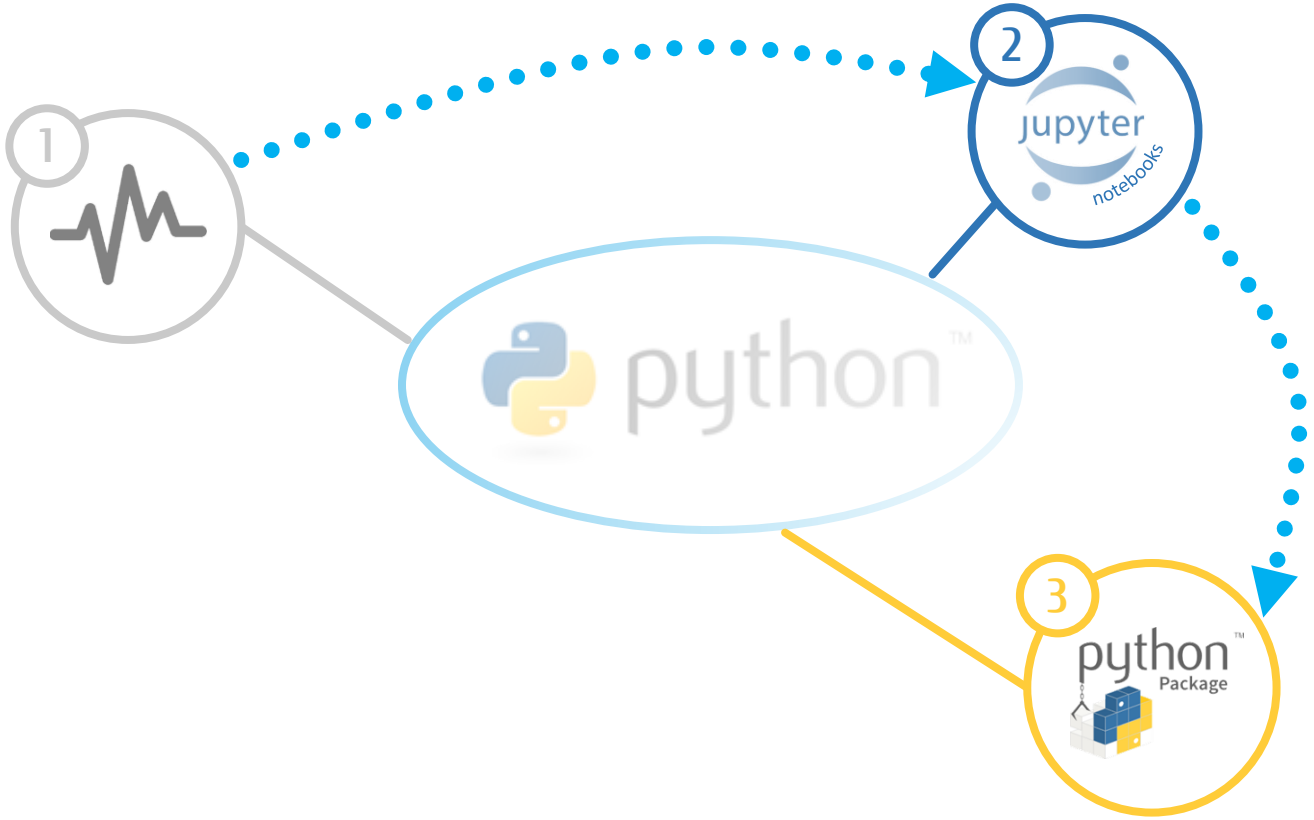



bioroots
notebooks

Description

Through Python language, some signal processing tasks (1) are illustrated following a step by step methodology supported by Jupyter Notebook (2) environment. This interactive experience can be complemented and developed with the biosignalsnotebooks (3) Python package, which synthesises the described processing functionalities in different modules and their functions.



biosignals notebooks

Jupyter Notebook

2017 ACM Software System Award

"Project Jupyter exists to develop open-source software, open-standards, and services for interactive computing across dozens of programming languages"

Highlights

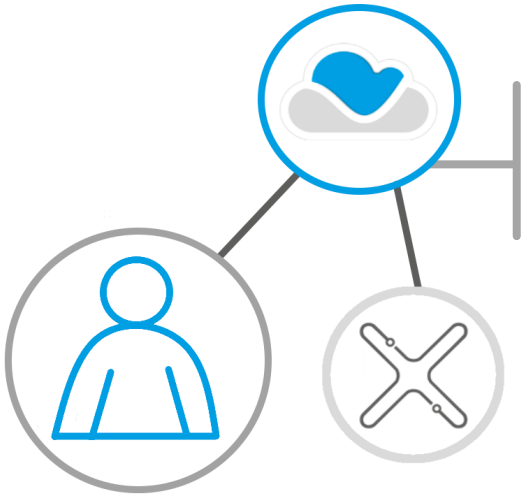
Used by

Google IBM Microsoft

biosignals notebooks

Purposes

Extension of OpenSignals



Open Contribution to the User

Facilitates Learning

biosignals notebooks

Notebook Categories

Data Acquisition

Record
- Configure
- Indicate
- Archive

Load
- Open
- Read
- Convert

Visualise
- Draw
- Interpret
- Zoom

- Pre and Post Record Tasks
- Data Access
- Graphical Data Visualisation

Signal Processing

Pre-Process
- Smooth
- Normalise
- Denoise
- Filter

Detect
- Recognise
- Segment
- Annotate

Extract
- Compute
- Generate
- Vectorise
- Optimise

- Multichannel Signal Processing
- Automatic Event Detection
- Extracted Feature Vector Generation

Machine Learning

Train
- Model
- Tune
- Train

Classify
- Decide
- Decode

Understand
- Analyse
- Explain
- Interact
- Imitate

Evaluate
- Compare
- Characterise
- Validate
- Report

- Application of Learned Knowledge
- Data Exploration
- Results Analysis

Notebook Categories

List of Notebooks

Data Acquisition

Record
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Signal Processing

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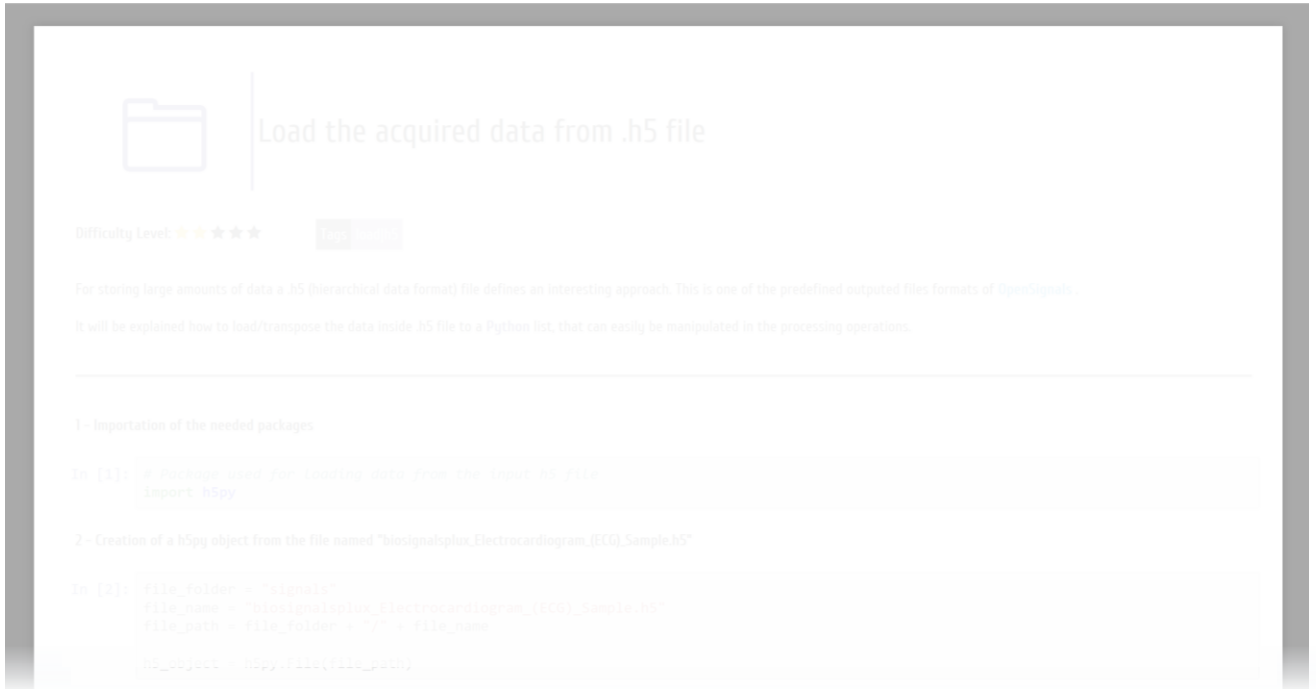
biosignals notebooks

Notebook Example



Demonstration

1. Signal Loading - Working with File Header;
2. Sample Rate and Resolution;
3. Load acquired data from .txt file;
4. Generation of a time axis;
5. Unit Conversion;
6. EMG Analysis – Parameter Extraction;
7. Stone, Paper or Scissor Game - Train and Classify.

biosignals notebooks

"Hands On" Challenge

- Determine the maximum, minimum and average duration of the muscular activation periods, after acquiring EMG data !

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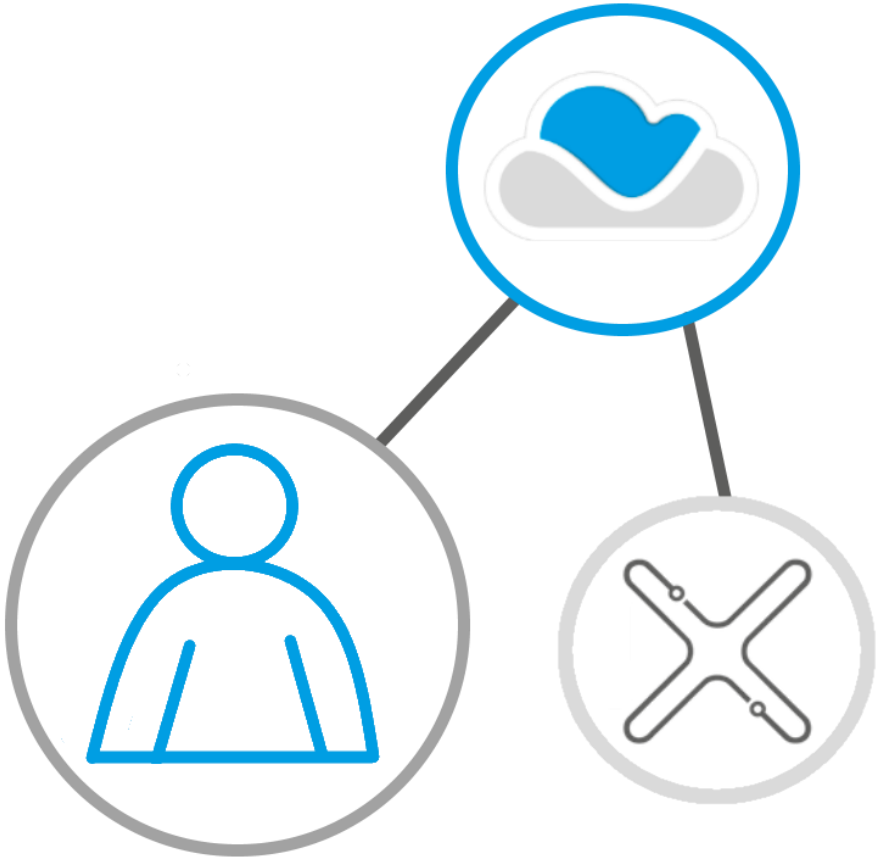
Image Source:

User Contributions



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