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beyond technology

Phytosensor

biosensor

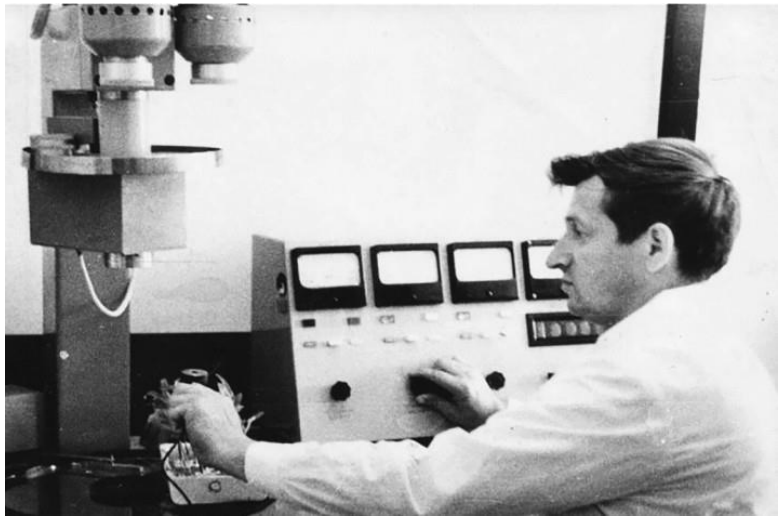
Phyto sensor

bio-hybrid

History of development

Phytosensing: using plants as a biological sensor, measuring physiological parameters, research field well-known from 80x

BIOTRON, Academy of Science, Kishinev, Moldova: end of 80x - begin of 90x, strong usage in agricultural purposes - optimization of production, fast tests of genetic hybrids



Long-term collaboration with **Prof. Dr. habil. Sergey Maslobrod** – "father" of plant electrophysiology, the institute of plant physiology and genetics, AS Kishinev

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History of development: bio-hybrid EU research

The *flora robotica* project develops and investigates bio-hybrid relationships between robots and natural plants and explore the potentials of plant-robot societies able to produce architectural artifacts and living spaces.

The project is funded by European Commission under the programme Future and Emerging Technologies, H2020 Project no. 640959.

flora **robotica**

The main goal of ASSISI project is to establish a robotic society that is able to develop communication channels to animal societies and bio-hybrid systems.

The project is funded by European Commission under the programme Future and Emerging Technologies, EU-FP7 Project no. 601074

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Bio-hybrid plant. What is it?

Biological organism

+

bio-hybrid interface device

=

Biological organism is capable for interactions with humans, environment and technologies, can change/adapt own living conditions/environments

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Sensors and information processing

Electrophysiological sensors
- differential bio-potential analyser
- differential tissue impedance spectrometer
- electrostimulation module

Physiological sensors
- leaf transpiration sensor
- sap flow sensor

Embedded environmental sensors
- environmental temperature, humidity, light
- air pressure
- RF power meter (450MHz-2.5GHz)
- 3D magnetic field/3D accelerometer

External/optional sensors
- Soil moisture, temperature
- CO2, O2, O3 (and other gas sensors)
- any I2C sensor

(Phyto-)actuators
- Irrigation, Light, Electrostimulation, CO2
- internal MOSFET switches
- external USB/I2C relay
- DMX512 interface
- Control of 6-24 DoF actuators

Connectivity and interfaces
- USB/Ethernet networks
- twitter and text message services
- (optional) GSM and Bluetooth
- speech TTS engine with flexible vocabulary

Information processing
- over 250 embedded processors for real-time signal analysis
- extended statistical module
- over 200 embedded actuators
- DA scripting language for sensor-actuator coupling
- Real-time data plot
- html-based plots for direct output in internet

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Applications

Entertainment
- plant-human interactions, talking/singing plants
- automated indoor plant installations
- integration of plants with technology

Home
- pathogenicity detector, ‘living’ environmental sensor
- home plant guard
- experimentation tool for plant enthusiasts

Science
- studying plant physiology and electrophysiology
- plant learning and plant-plant interactions
- automated analysis of large physiological data

Agriculture/environment
- optimization of growth processes
- automatization based on physiological processes
- outdoor urban/forest biosensors

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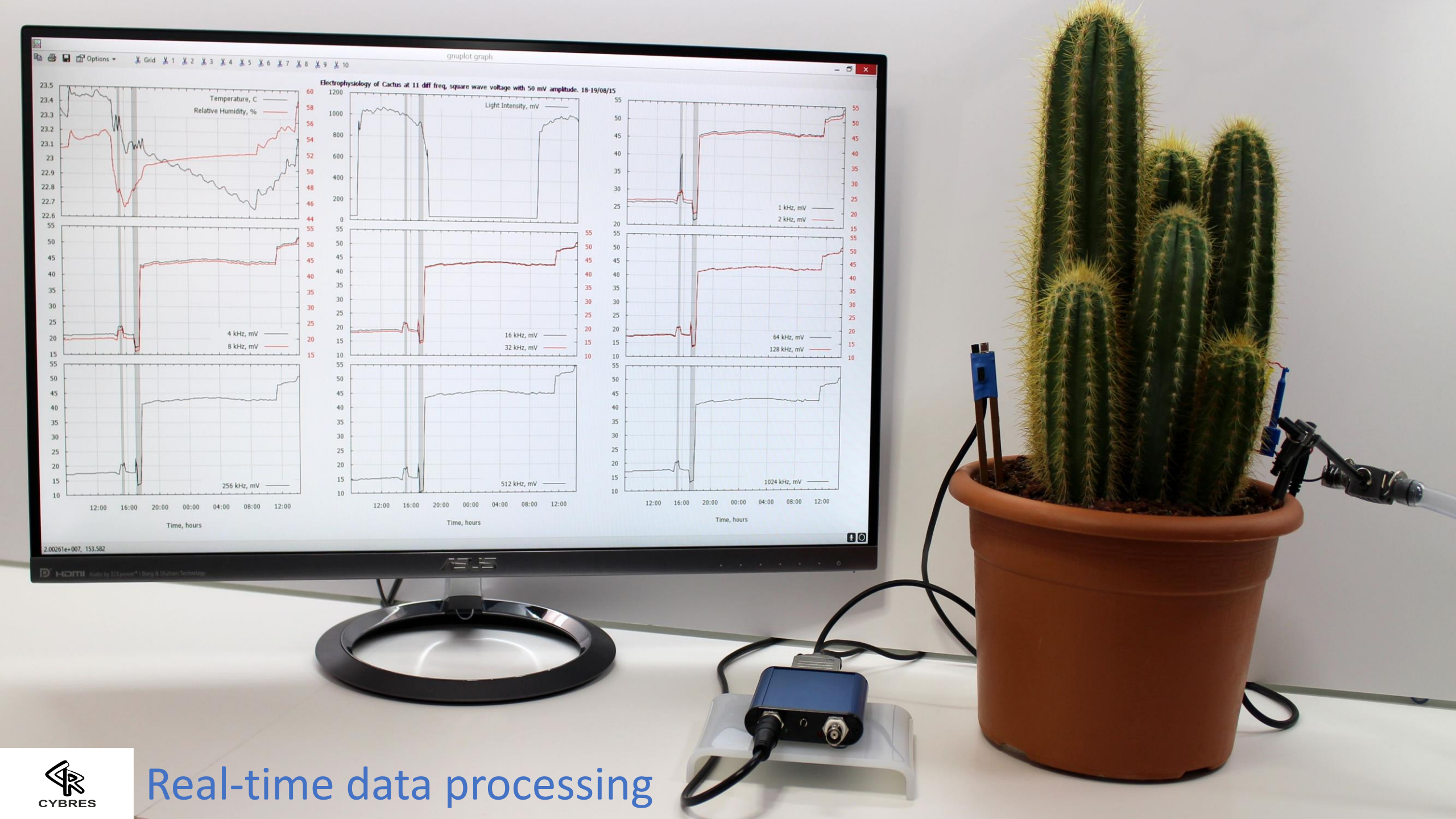

Real-time data processing

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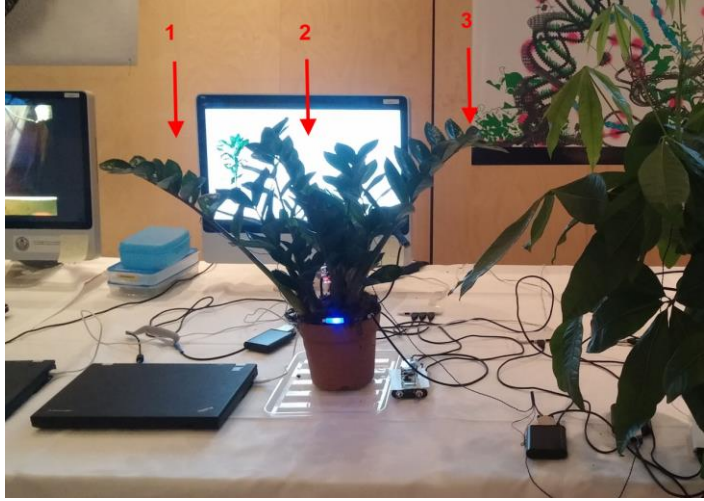
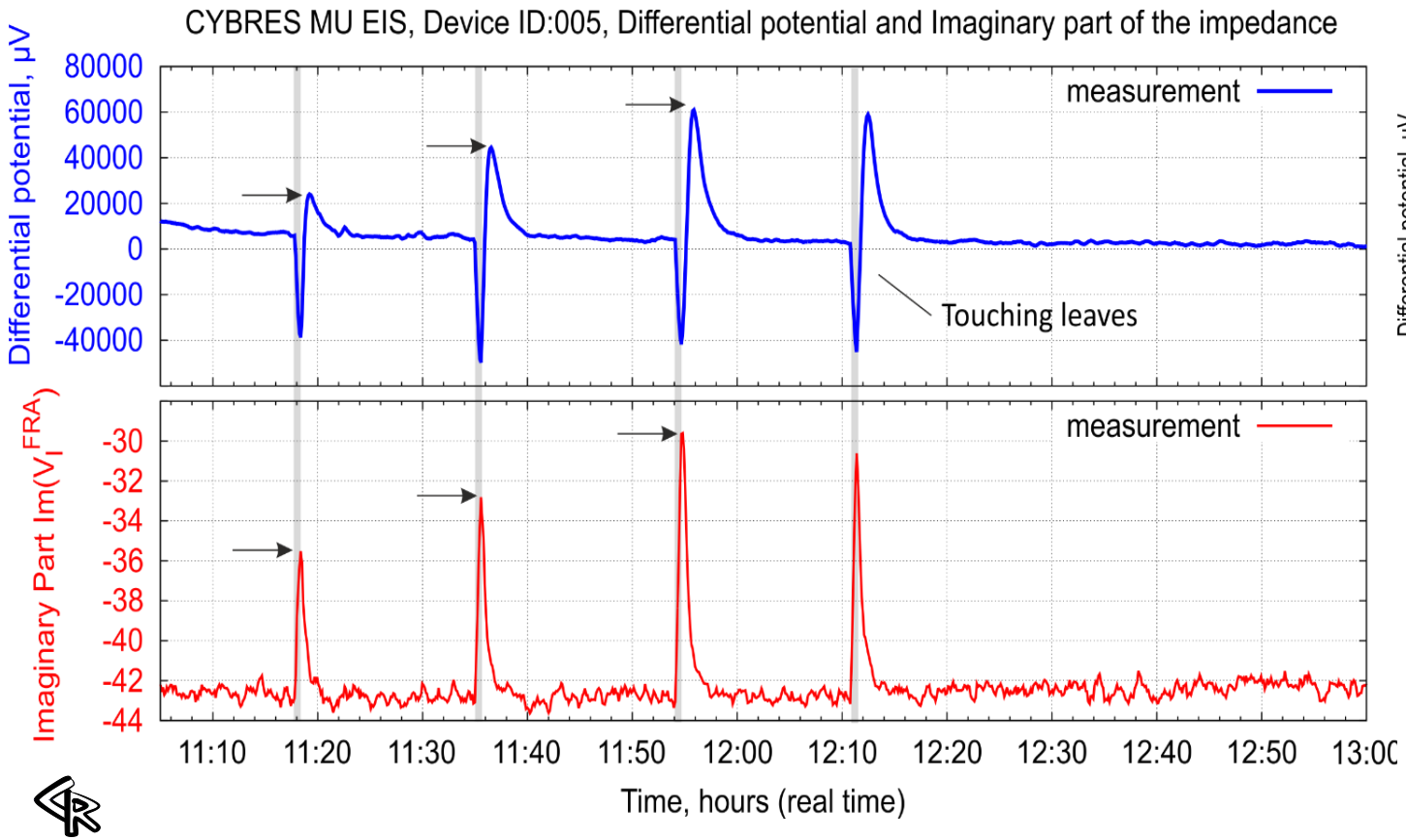
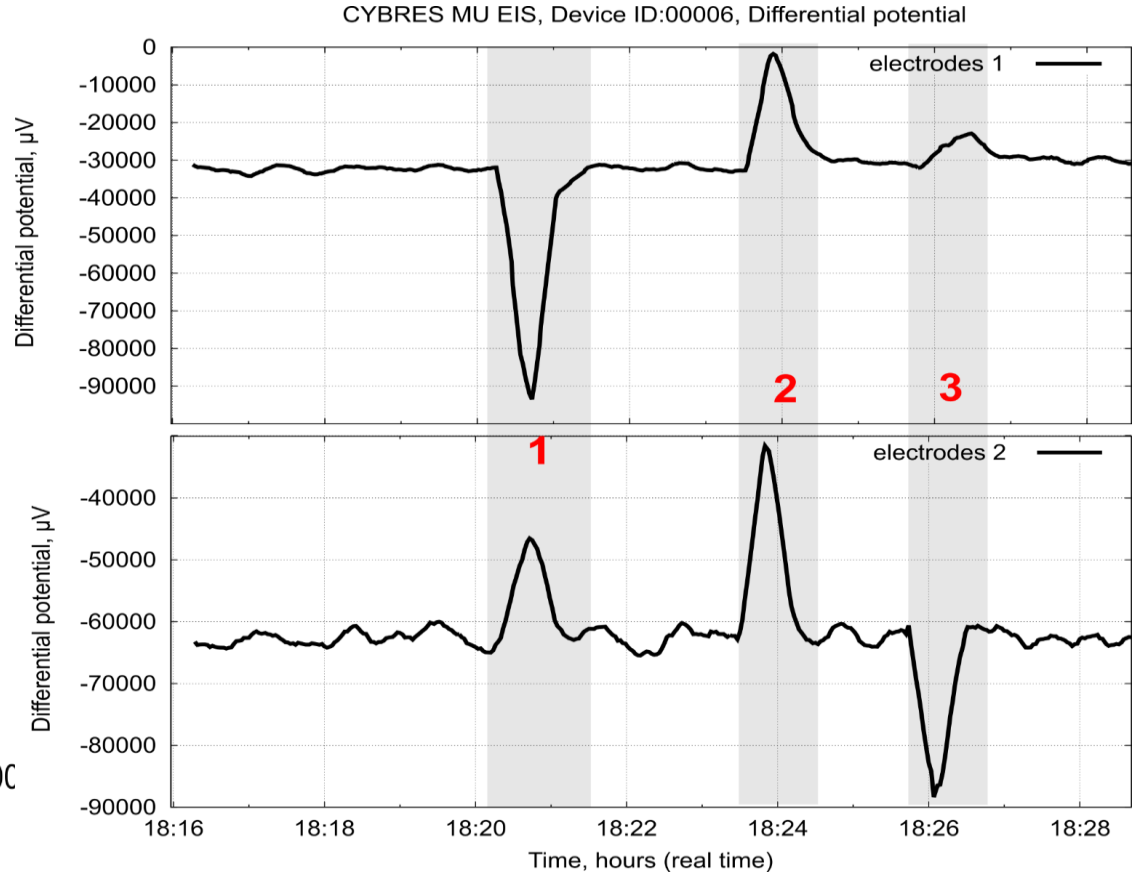
Example: Electrophysiology







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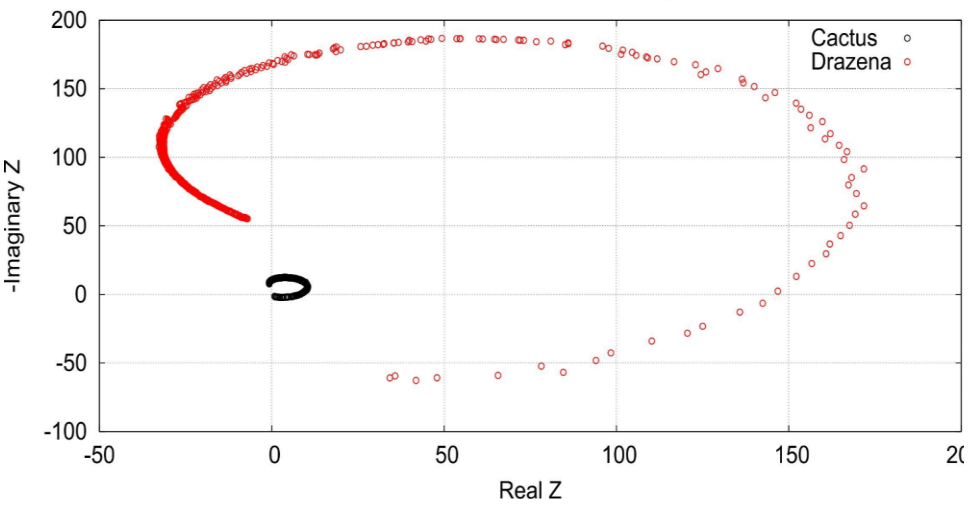
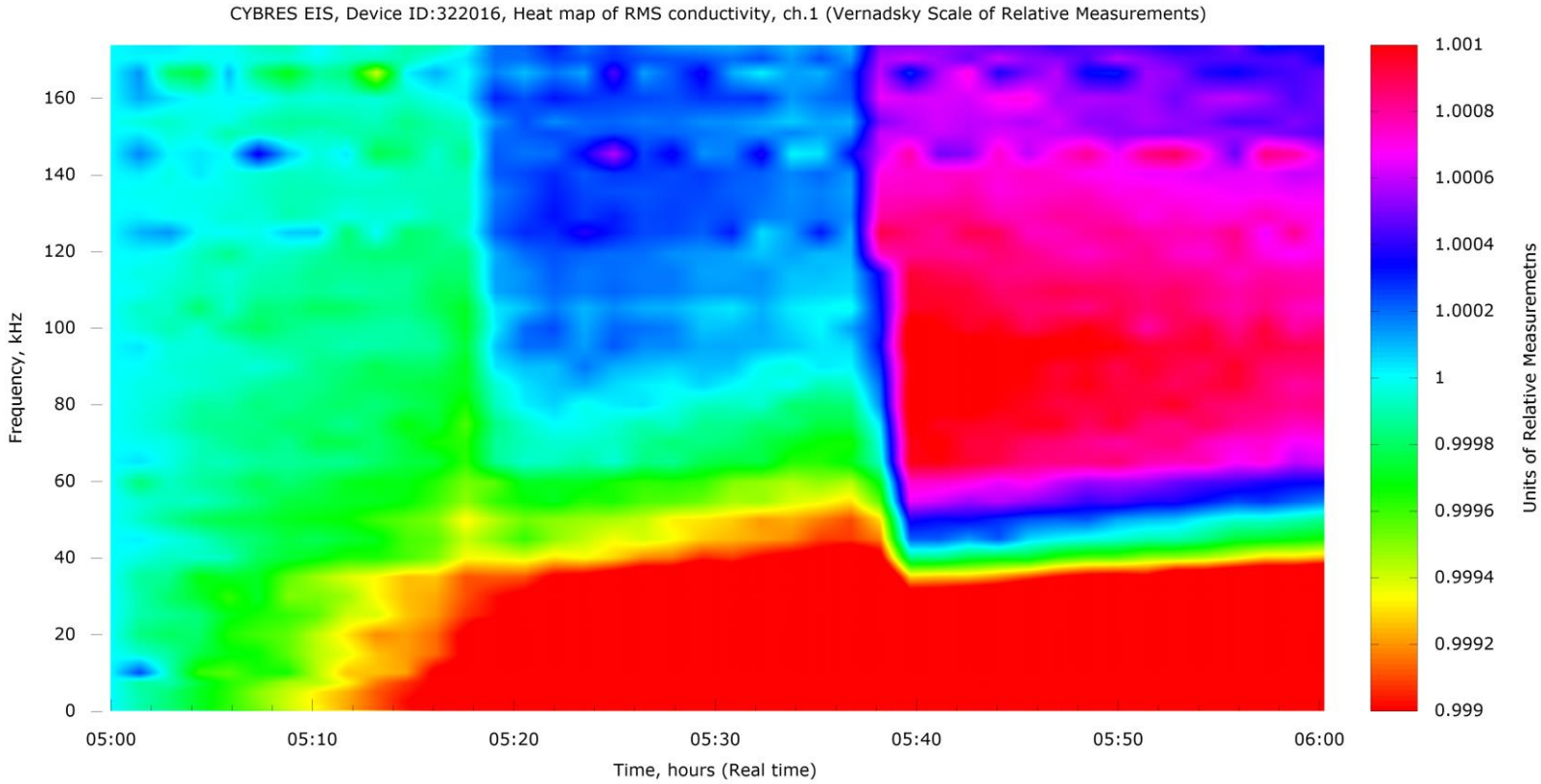
Example: tissue impedance spectroscopy





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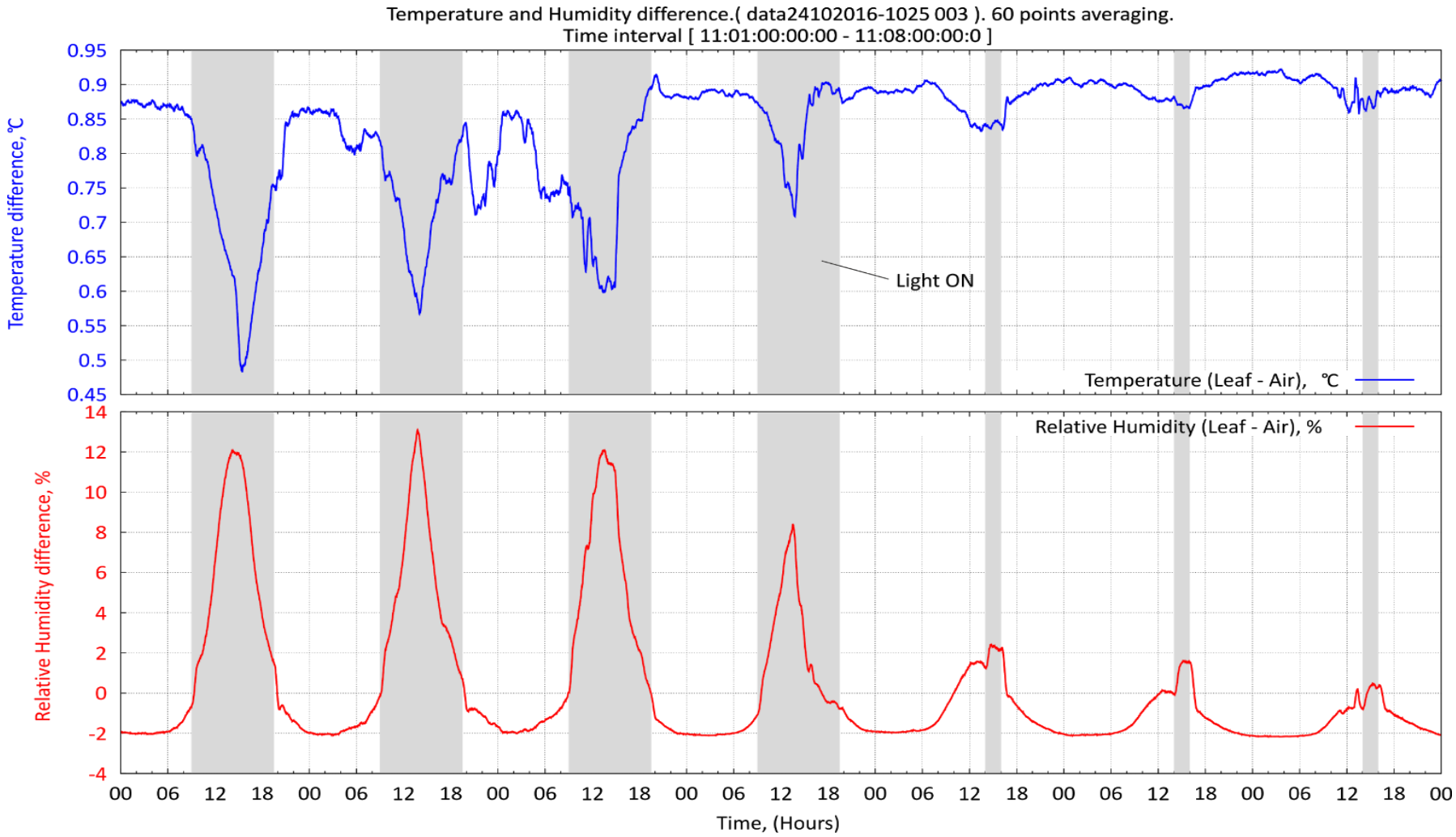
Example: transpiration data



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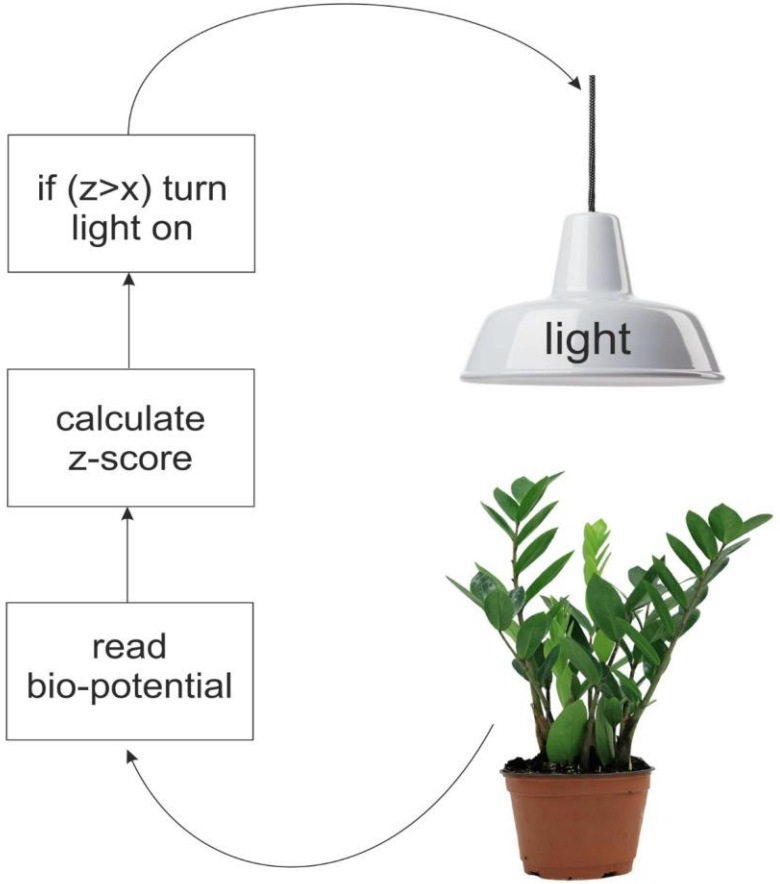
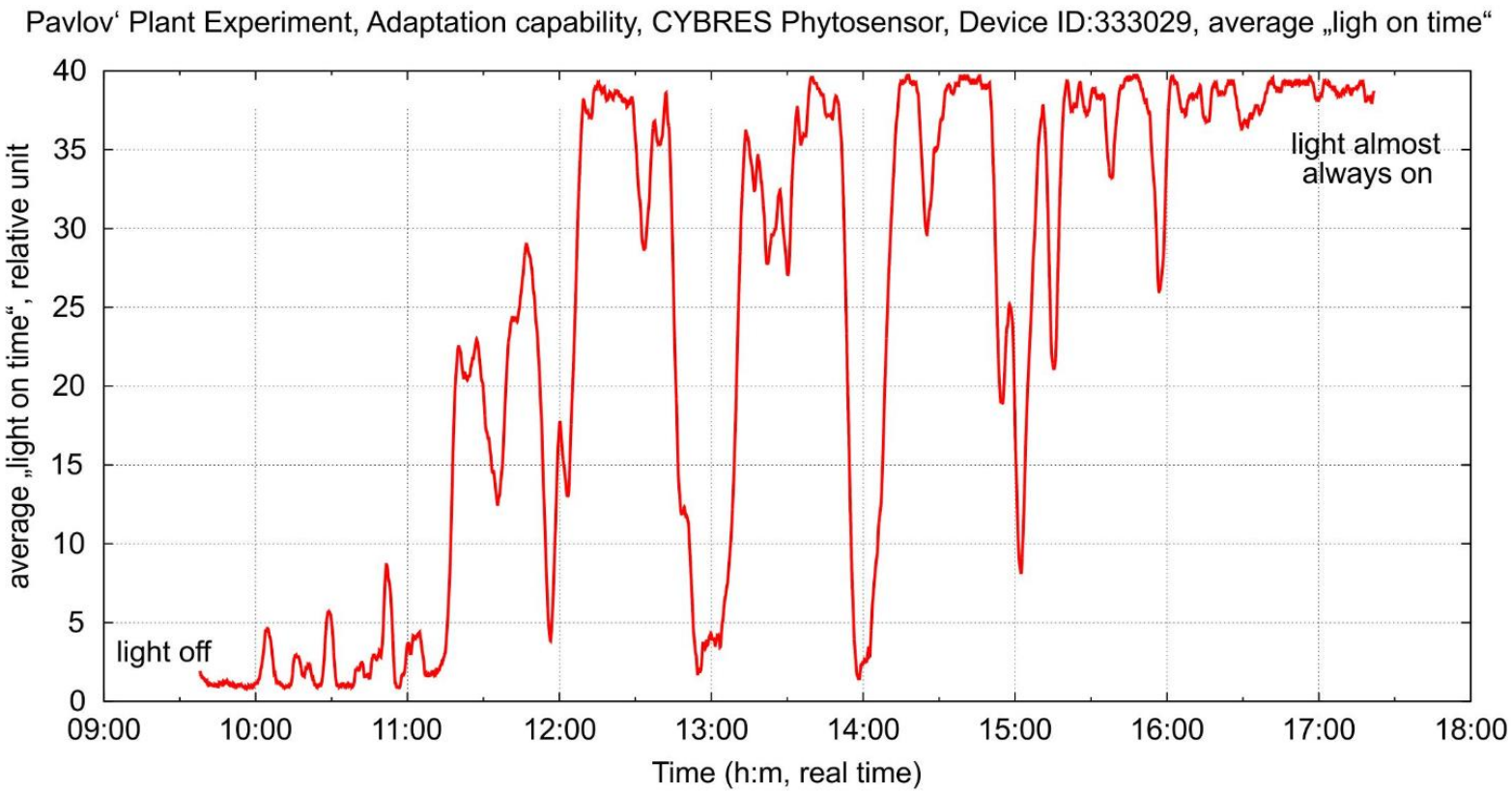
Example of phyto-actuation

Imposed feedback loops based on measuring biopotentials





the plant self-regulates illumination in own environment

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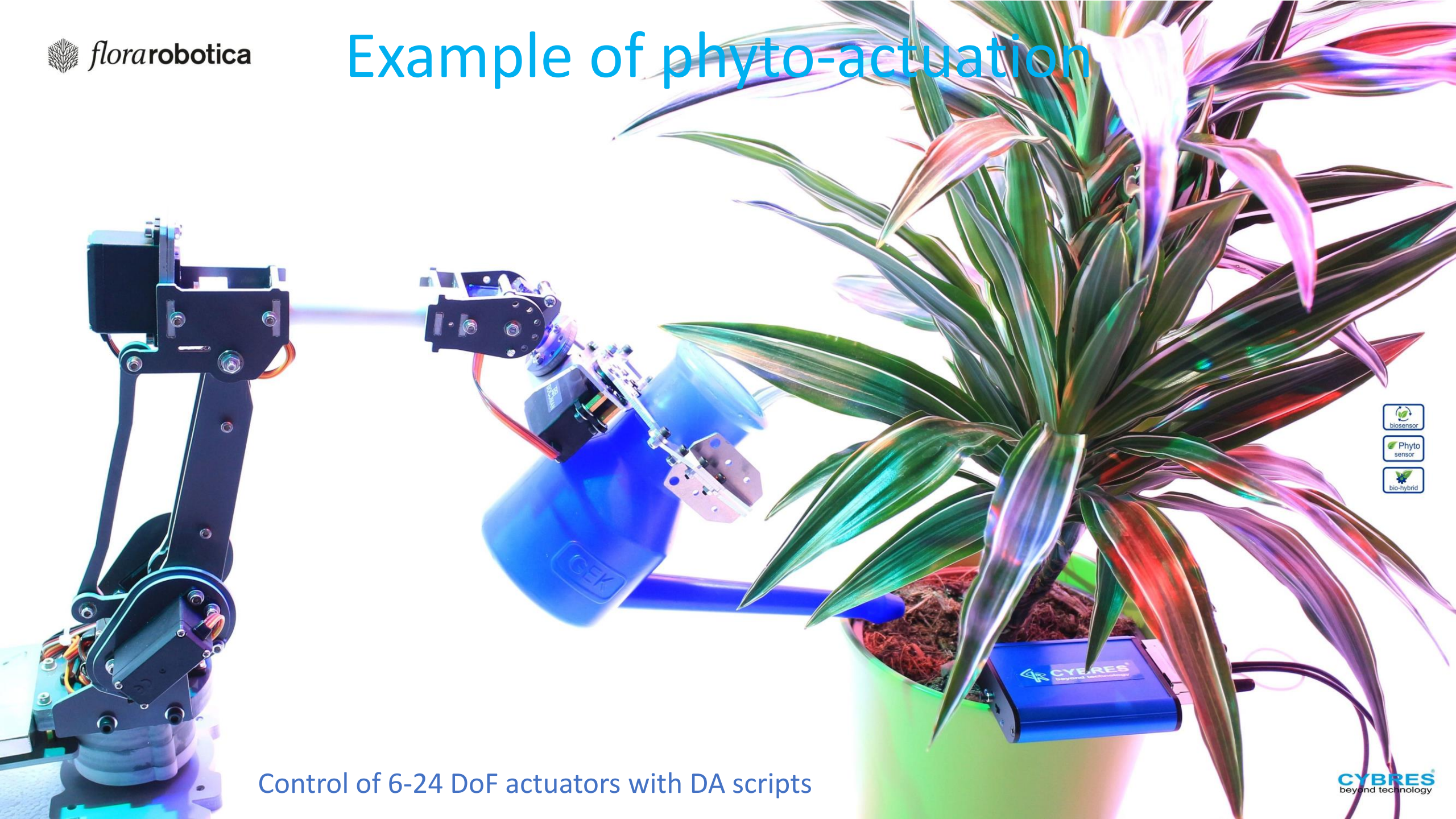
florarobotica

Example of phyto-actuation



Control of 6-24 DoF actuators with DA scripts

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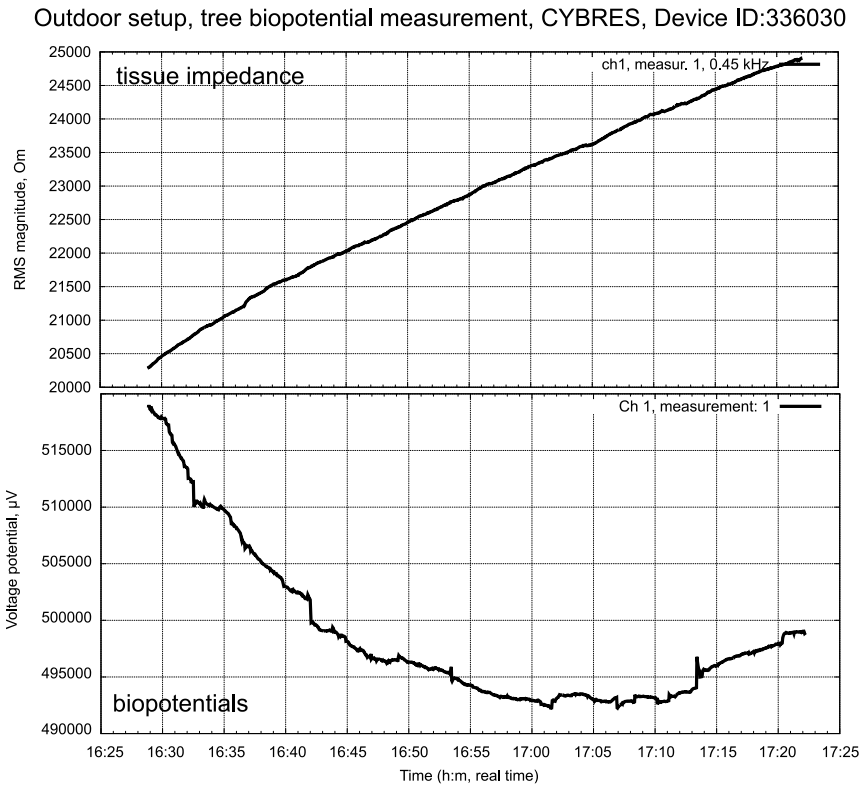
Outdoor setup (tree) for urban/forest measurements



- Solar cell powering
- WiFi connectivity
- Waterproof IP66 packaging

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explore the world of

Intelligent plants

biosensor

Phyto sensor

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