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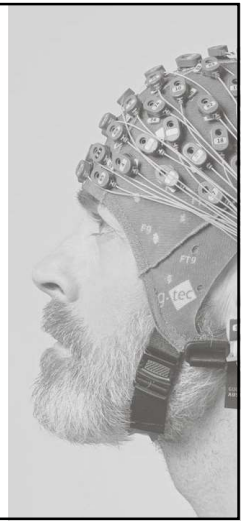
NEUROTECHNOLOGY

www.recoveriX.at

Micah Ching
G.tec Neurotechnology Hong Kong Limited



Brain-Computer Interfaces for Stroke Rehabilitation

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Companies

- Guger Technologies OG, Graz, Austria
- g.tec medical engineering GmbH, Schiedlberg, Austria
- g.tec medical engineering Spain SL, Barcelona, Spain
- g.tec neurotechnology USA Inc., Albany, USA
- g.tec neurotechnology Hong Kong Inc., HK

Research Projects

- **H2020 Eurostars: seizureAI** – epilepsy monitoring and deep learning with EEG
- **H2020 Eurostars: ComaAid** – combination of EEG and fNIRS for DOC patients
- **H2020 Eurostars: EEG-DDS –** combination of EEG with decision support system
- **FFG: BrainGait** – combination of BCIs for rehabilitation with treadmills
- **H2020: MultiSense** – combination of DBS with physiology
- **FFG: recoveriX-Leg** – lower limb stroke rehabilitation with BCI
- **H2020: Rhumbo** – magnetic stimulation of the cortex

Research Projects

- **H2020: HOPE** – high frequency oscillation detection in epilepsy
- **H2020 ITN: Pro-Gait** – combination of BCIs with exoskeletons
- **H2020 ITN: DOCMA** – international training network for BCIs and DOC
- **Marie-Curie: MoveAgain** – combination of recoveriX with TMS, tDCS
- **H2020: Astonish** – fNIRS and EEG
- **H2020 Eurostars: ComAlert** – coma prediction
- **EC Flagship: Graphene** – development of Graphene electrodes

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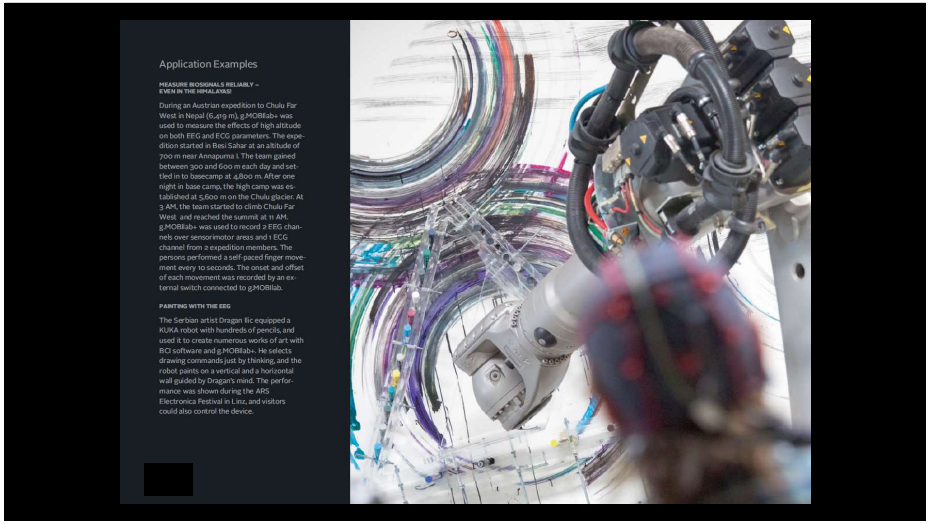

Application Examples

MEASURE BIOSIGNALS RELIABLY – EVEN IN THE HIMALAYAS

During an Austrian expedition to Chulu Far West in Nepal (6,419 m), g.MOBIlab+ was used to measure the effects of high altitude on both EEG and ECG parameters. The expedition started in Rest Sahar at an altitude of 700 m near Annapurna I. The team gained between 300 and 600 m each day and settled in to basecamp at 4,800 m. After one night in base camp, the high camp was established at 5,600 m on the Chulu glacier. At 3 AM, the team started to climb Chulu Far West and reached the summit at 11 AM. g.MOBIlab+ was used to record 2 EEG channels over sensorimotor areas and 1 ECG channel from 2 expedition members. The persons performed a self-paced finger movement every 10 seconds. The onset and offset of each movement was recorded by an external switch connected to g.MOBIlab.

PAINTING WITH THE EEG

The Serbian artist Dragan Ilic equipped a KUKA robot with hundreds of pencils, and used it to create numerous works of art with BCI software and g.MOBIlab+. He selects drawing commands just by thinking, and the robot paints on a vertical and a horizontal wall guided by Dragan's mind. The performance was shown during the ARS Electronica Festival in Linz, and visitors could also control the device.

Application Examples

The first Cybathlon took place on October 8th, 2016 at the ETH Zurich. People with disabilities competed side by side at the Brain-Computer Interface Race (BCI Race). Pilot Numa Poujouly from the Team BrainTweakers from École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland won Gold in the BCI Race using his brain waves to control an avatar along a race-track on a virtual train. The game is called "BrainRunners" and was specially developed for the Cybathlon's BCI Race. The Brain Tweakers have been using high-quality g.tec equipment.

g.USBamp Research Edition

g.USBamp RESEARCH is the non-certified version of g.USBamp. Therefore, it is less expensive and intended to be used for research applications only. The device has freely accessible and configurable features, although any kind of ECoG experiments are excluded.

User Experience

Natalie Mrachacz-Kersting, PhD, Associate Professor
Aalborg University, Denmark

"We have used the g.USBamps for approximately four years now, and the quality of the signals surpasses our greatest expectations. Last year, we also invested in the g.Nautilus system, and have been able to move from more stringent laboratory conditions to real world settings, where BCIs are becoming more prominent. I would highly recommend both systems to anyone involved in BCI research."

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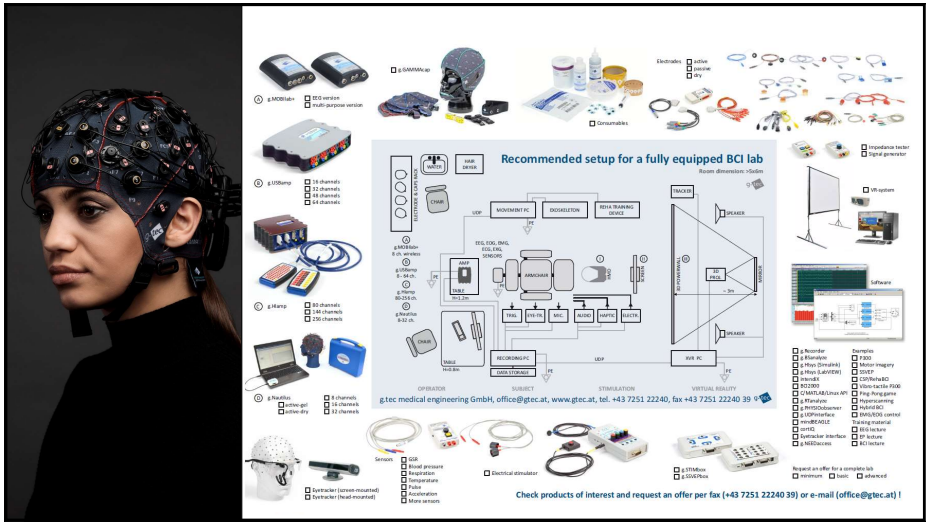
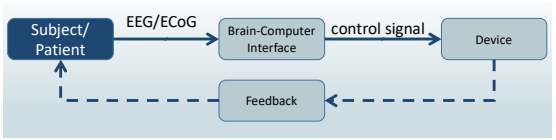


Brain-Computer-Interface (BCI)



"A system for controlling a device e.g. computer, wheelchair or a neuroprothesis by human intention which does not depend on the brain's normal output pathways of peripheral nerves and muscles" [Wolpaw et al., 2002].

- HCI – Human Computer Interface
- DBI – Direct Brain Interface (University of Michigan)
- TTD – Thought Translation Device (University of Tübingen)

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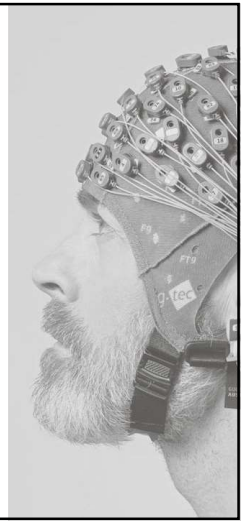
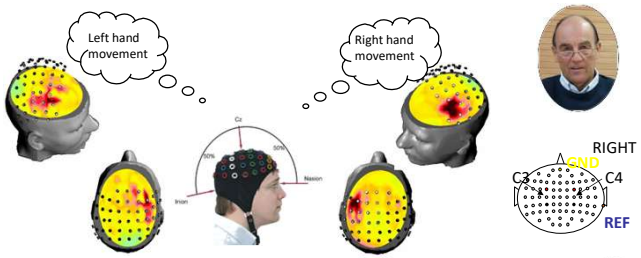


Physiological background

Imagination of hand movement causes an ERD which is used to classify the side of movement. The desynchronization occurs in motor and related areas of the brain.



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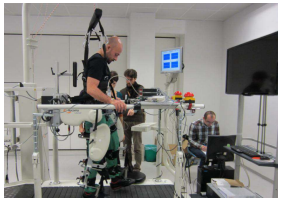
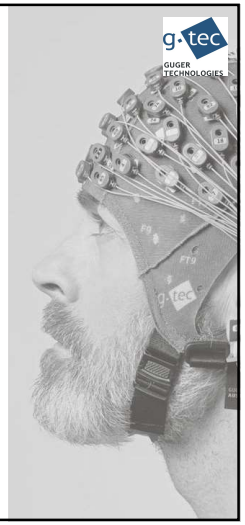
Stroke Rehabilitation

- Motor imagery (MI) based rehabilitation was proven to be an effective therapy.
- BCI based stroke rehabilitation combines a physical therapy with BCI-based motor imagery decoding into an integrative rehabilitation strategy





How recoveriX works

We combine:

- Motor imagery
- Functional electrical stimulation
- Visual feedback via the movement of virtual hands (Mirror therapy)

- Simultaneous stimuli (Activity of the motor cortex + actual movement of the hand + visual feedback)
  - →Plasticity of the brain is supported to recover motor functions
  - →Reduce negative symptoms

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How recoveriX works

- Measures EEG signals and instructs the patient to imagine a left/right hand movement
- BCI detects if the corresponding motor cortex is activated
  - → Trigger a electric stimulation
  - → Display movement of an avatar hand (VR) = Mirror therapy
- Movement of the hand + Mirror neurons activates the sensorimotor cortex
  - → More activation in the brain

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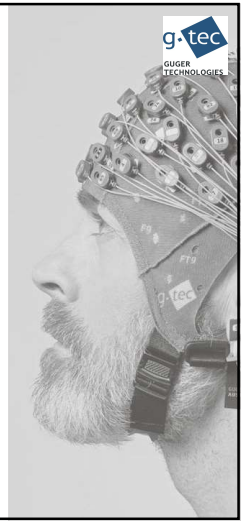
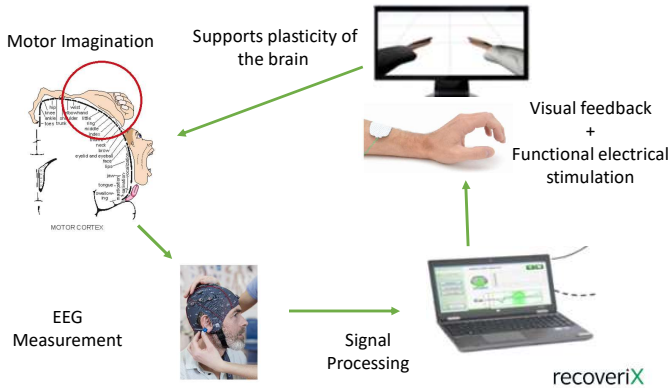
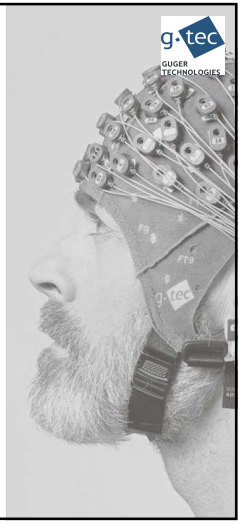
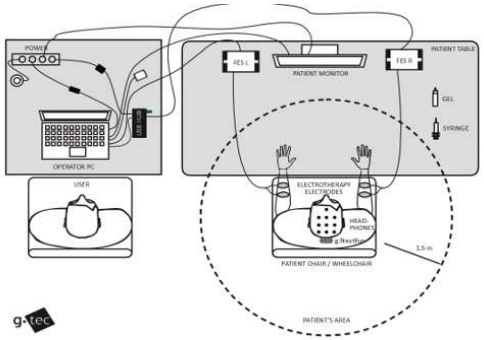


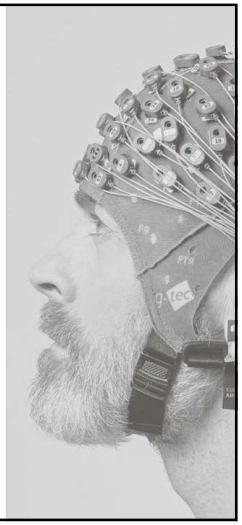
How recoveriX works





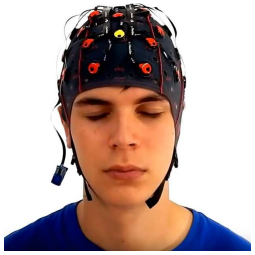
recoveriX setup





recoveriX setup

EEG gel to the electrodes



FES electrodes to Extensor digitorum communis muscle

Start setting the stimulation with the healthy side!

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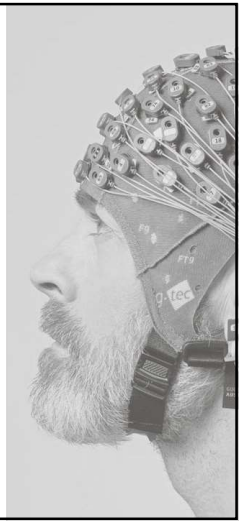

Videos

EEG montage, FES placement, therapy – video

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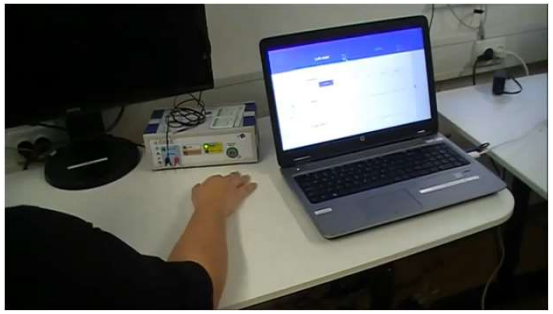
FES electrode placement



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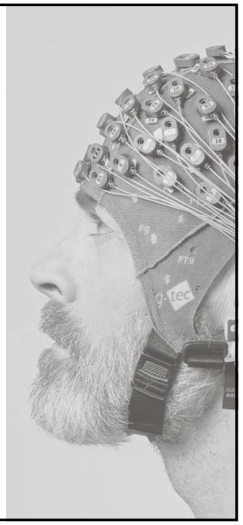
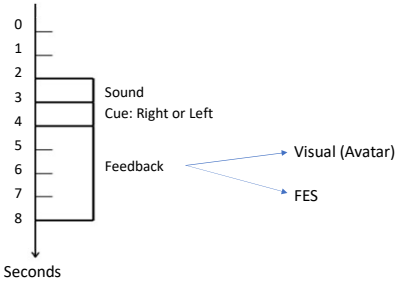


rX paradigm



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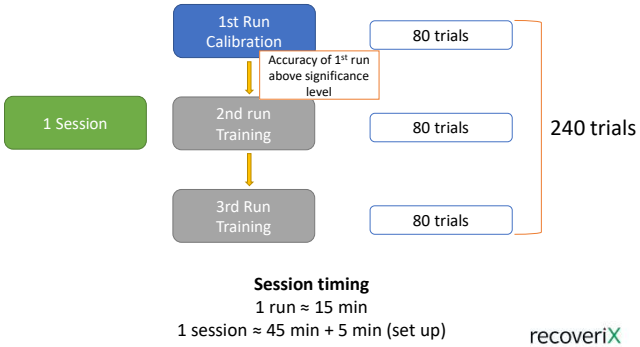
rX session



Session timing
1 run ≈ 15 min
1 session ≈ 45 min + 5 min (set up)

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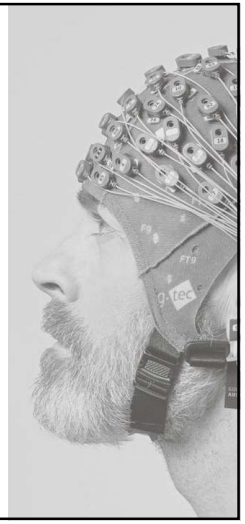
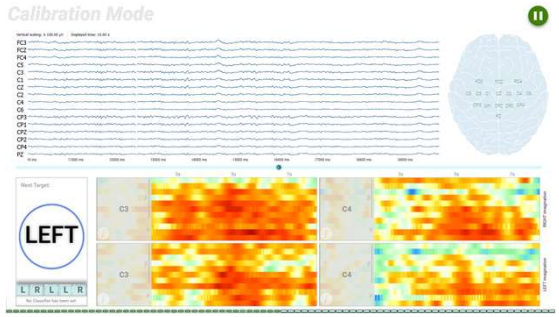


rX User Interface



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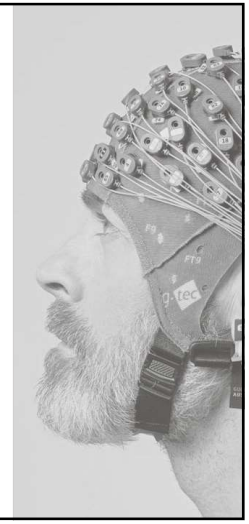

Patient report

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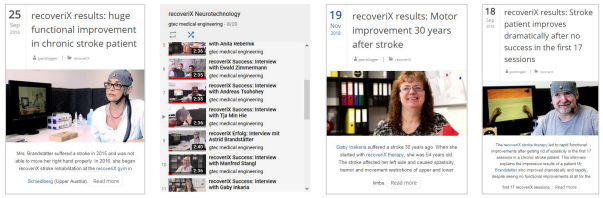
Read more about recoveriX

- recoveriX Website: www.recoveriX.at
- recoveriX Results: www.recoveriX.at
- recoveriX Patient Interviews: www.youtube.at/gtecmedicalengineering



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