



WYSS CENTER



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Novel technology for chronic BCI in the home

September 29, 2020

CHIST-ERA Conference 2020



Overview

- Non-profit foundation in **Geneva** focused on **neuroscience** research, innovation and **translation**
- ~ 40 staff at the Center including operations, science and technology R&D and translation
- Numerous **collaborations** with Academic, Clinical and Industrial partners
- Neural interface technology for reading and writing to the nervous system in **humans**
- Projects focus on neurotechnology, neuroradiology and neurobiology



Interdisciplinary teams that unite the best of academia and industry

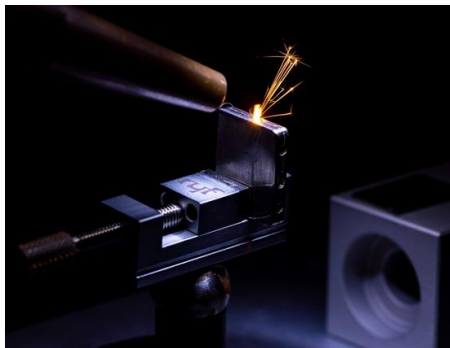
In-house expertise



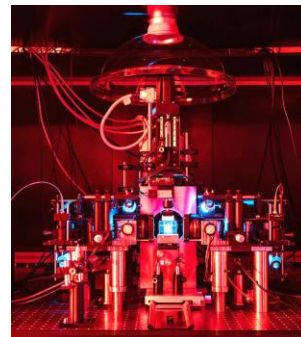
- Neuroscience
- Engineering
- Software engineering
- Microelectronics
- Imaging
- Clinical
- Regulatory
- Legal
- Business
- Entrepreneurship

In-house capabilities

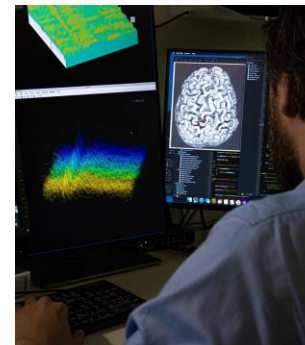
Neurotechnology prototyping



Neurobiology



Data analysis and software development



Quality, regulatory and clinical support





Novel technology for chronic BCI in the home



Epios™

Long-term brain monitoring and therapeutics for personalized management of neuro-disorders



ABILITY

An implantable brain-computer interface to restore movement and communication

Challenges addressing:

- **Human grade** technology for **chronic** interfacing with the brain
- **24/7** recording capabilities
- Platform solutions for **data processing** and **analytics**
- **User-friendly software** that does not require an expert to calibrate each day



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Epios™

Subcutaneous EEG: Enabling long-term recording in daily life



SCALP EEG

- ✗ Interferes with daily life
- ✗ Unstable signals
- ✗ Short-term only



Intracranial EEG

- ✗ Craniotomy
- ✗ Hospitalization
- ✗ Limited coverage



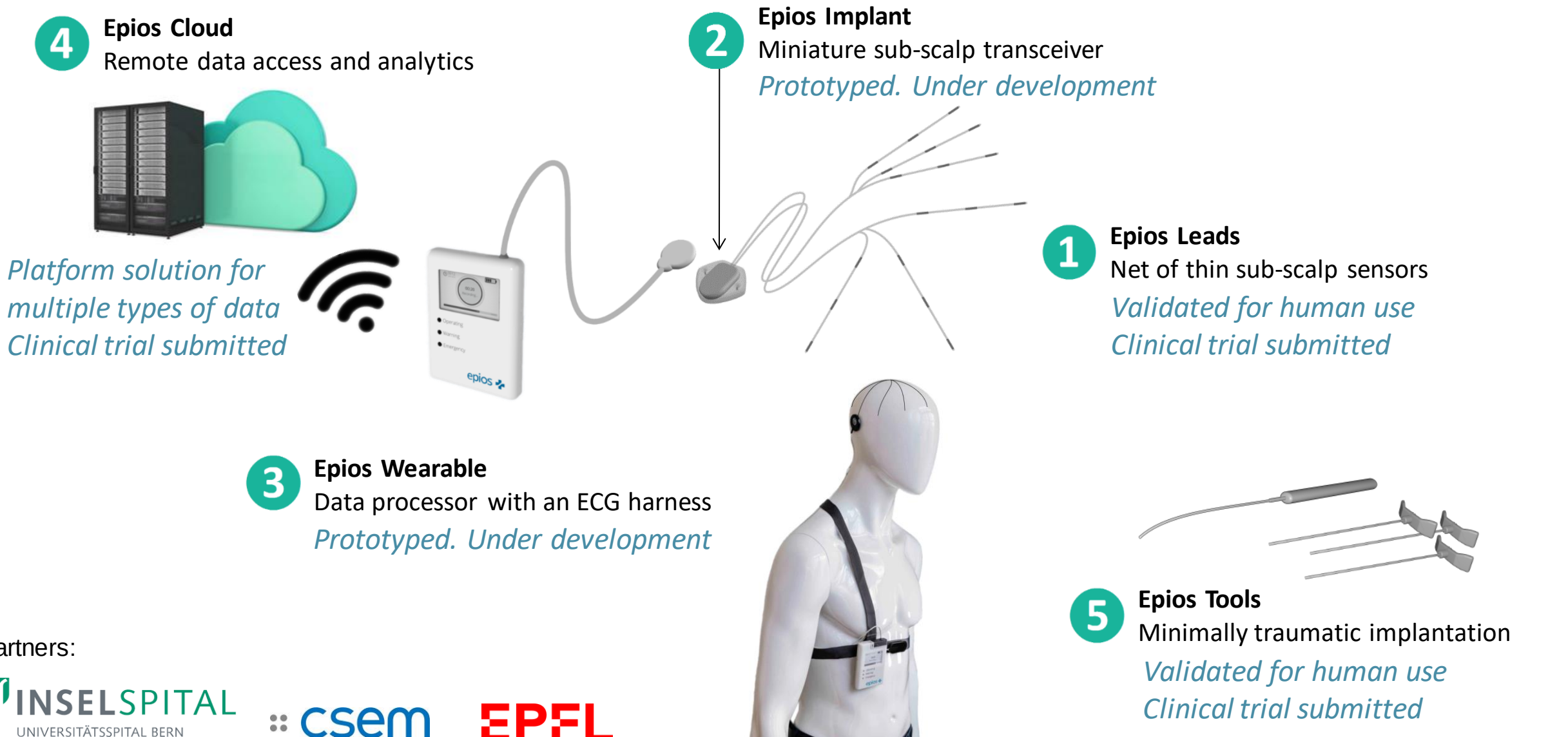
SUBCUTANEOUS EEG

- ✓ Unobtrusive
- ✓ Long-term (many months)
- ✓ Broad spatial coverage



epios 

Eplos system components



Partners:

INSELSPITAL
UNIVERSITÄTSSPITAL BERN
HÔPITAL UNIVERSITAIRE DE BERNE

•• **csem**

EPFL

<https://www.wysscenter.ch/advances/eplos-brain-monitoring>

Epios roadmap and indications



MONITORING



- Sub-scalp brain monitoring
- Raw data for six-plus months
- Proof of concept in epilepsy

REAL-TIME



- Process data in real-time
- Neurofeedback
- Chronotherapy
- **BCI**
- Epilepsy
- Spinal cord injury (SCI)
- Tinnitus
- Sleep

STIMULATION



- Electrical stimulation for treatment
- Epilepsy
- Stroke
- Psychiatric disorders
- Tumors (GBM)



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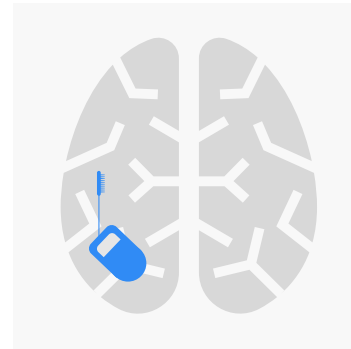
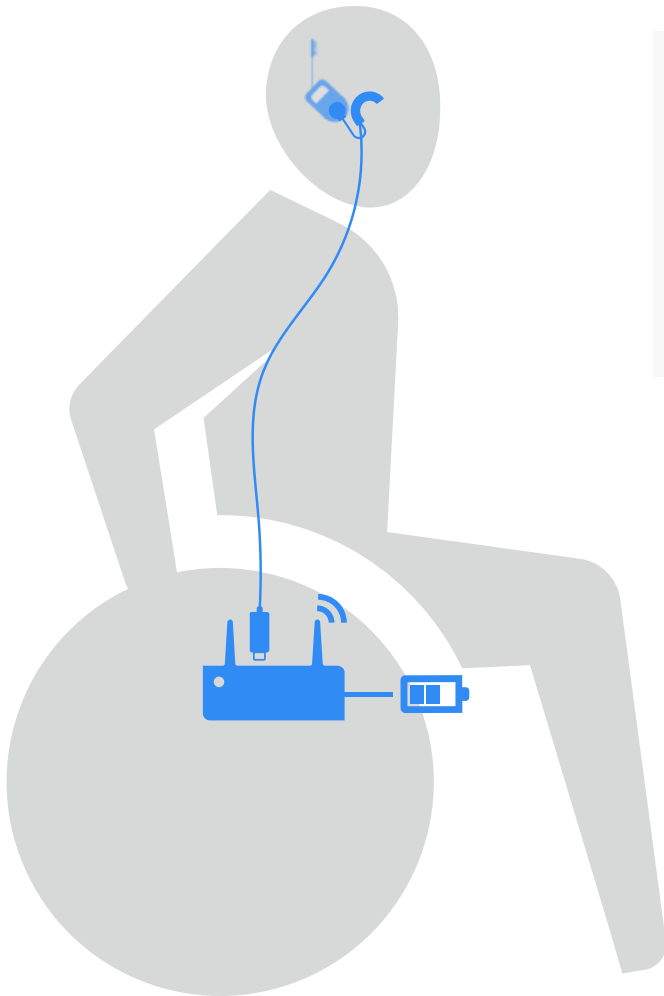
ABILITY (Active Brain Implant Live Information Transfer sYstem)

An implantable brain-computer interface to restore movement and communication

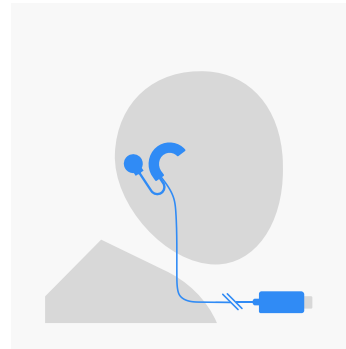
NeuroKey Software



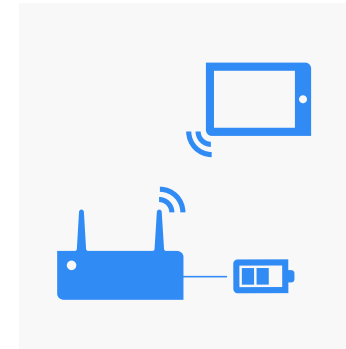
The ABILITY system and its components



Implant and
connected
electrodes



Wearable
(head piece, ear
piece and
adaptor)



Data processor
NeuroKey PC
running SW

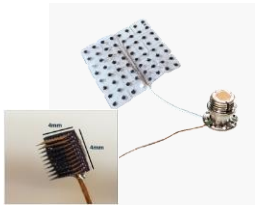


Data visualization



The ABILITY implant

- **High channel count** allows continuous high-resolution recording of brain signals
- **Wireless transmission** of broadband neural data
- **Battery-less** operation and encapsulation in a protective housing with **hermetic sealing** and **biocompatible materials** will allow the implant to function in the body for years
- Designed to be flexibly connected to a variety of **electrode technologies** such as



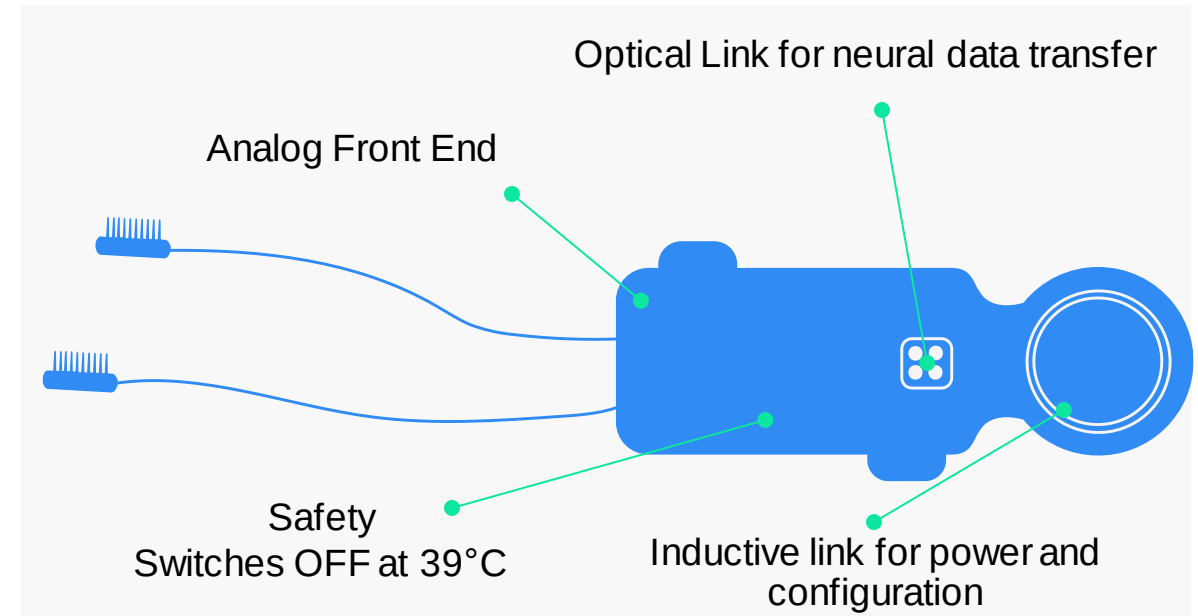
Blackrock
Arrays



SOFT
ECoG™ strip



Epios
subcutaneous leads



- Similar in size to a cochlear implant
- Design compliant with **medical device standards**
- **Manufacturable**

Partners:

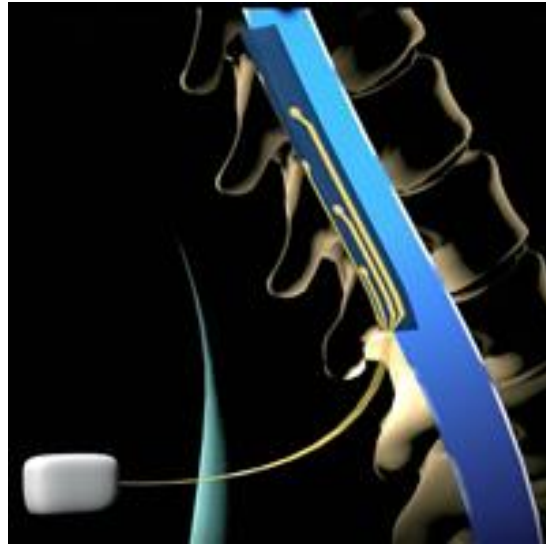




Applications



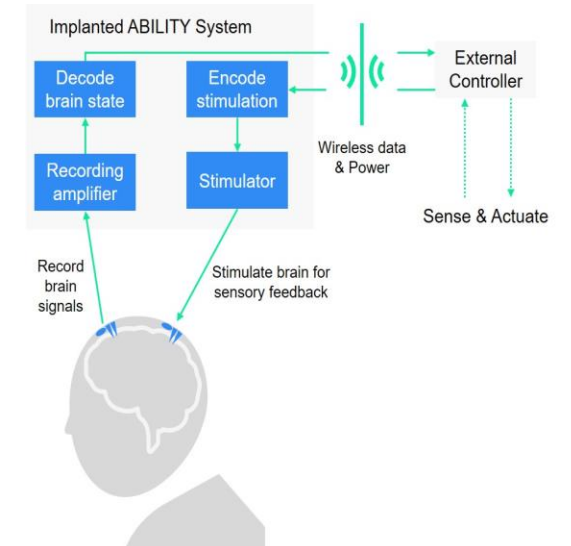
Restoring reach and grasp
in tetraplegia and **stroke**
patients



Restoring reach and grasp
or walking in patients
following **spinal cord**
injury



Enabling communication
with people “locked-in” as
a result of **Amyotrophic**
Lateral Sclerosis (ALS)



Closing the loop for
sensory feedback direct to
the cortex



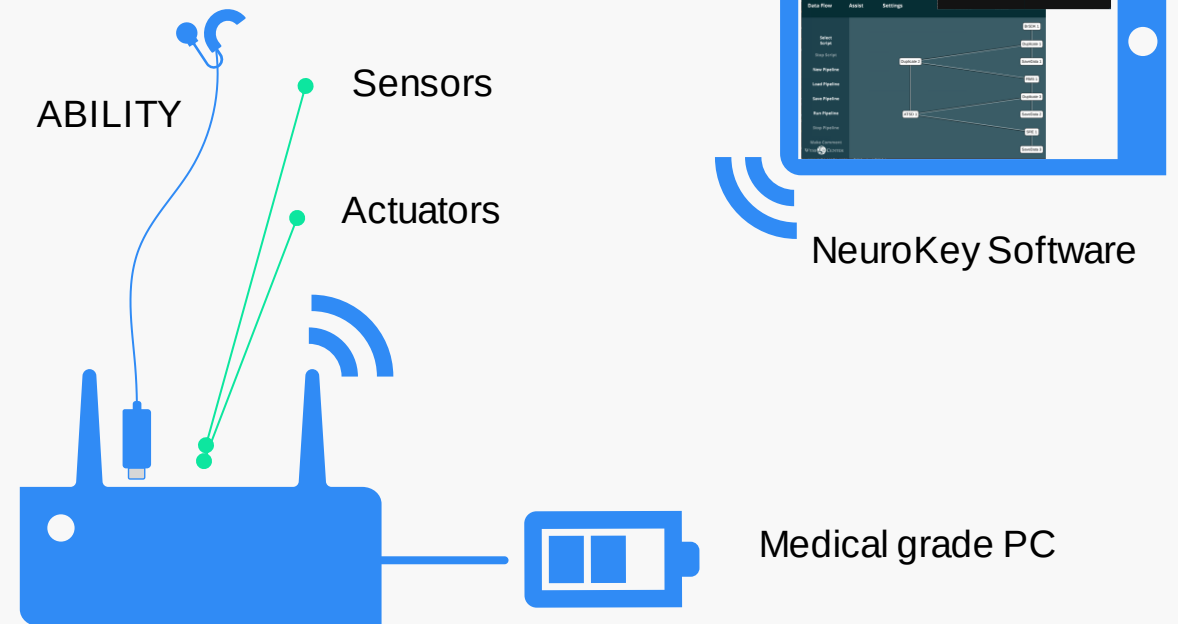
NeuroKey

Software for neural interfacing applications

- **Data processing platform** for **real-time** neurophysiological data
- **Medical grade**
- **Decode signals and send commands** to external actuator(s) e.g. computer, robotic arm, exoskeleton, spinal Cord stimulator, FES

Key features

- Portable
 - Modular
 - Flexible
- }] User-friendly for research and clinical applications
- «Universal», i.e. compatible with different implants, commercial hardware and sensors
 - Medical device developed following regulatory path
 - **Goal:** Autonomous use by non-scientific personnel (e.g. caretaker or patient)



Partners:

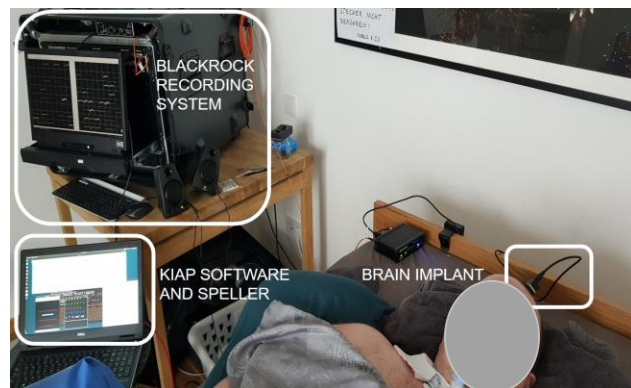


Utrecht University

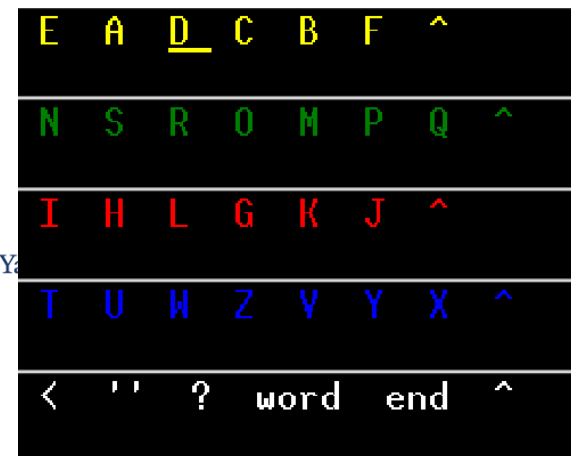
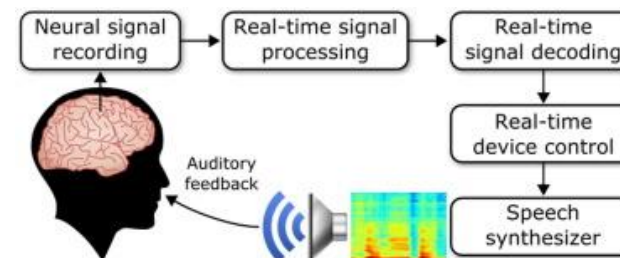




KIAP clinical case



- **Completely locked-in** patient implanted with NeuroPort array in March 2019
- Patient modulates brain activity and receives auditory feedback
- NeuroKey allows communication
- **Next step:** Improve NeuroKey for autonomous home use by the family



medRxiv
THE PREPRINT SERVER FOR HEALTH SCIENCES



Verbal Communication using Intracortical Signals in a Completely Locked In-Patient

Ujwal Chaudhary, Ioannis Vlachos, Jonas B Zimmermann, Arnau Espinosa, Alessandro Tonin, Andres Jaramillo-Gonzalez, Majid Khalili-Ardali, Helge Topka, Jens Lehmberg, Gerhard M Friehs, Alain Woodtli, John P Donoghue, Niels Birbaumer
doi: <https://doi.org/10.1101/2020.06.10.20122408>

This article is a preprint and has not been peer-reviewed [what does this mean?]. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice.

Partners:



Utrecht University



Meeting challenges... through collaboration

- Partnerships to further develop technology and expand use cases/novel interactions
- Research in daily life is important
- Focused multi-disciplinary research efforts requiring niche expertise and big resources
- BCIs will not become ubiquitous until they are seamless in our daily life



Get in touch

Thank You!

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