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SpineRepair RTD 2013

FNSNF

Integrated Spinal Neuroprosthesis for Functional Recovery following Spinal Cord Injury

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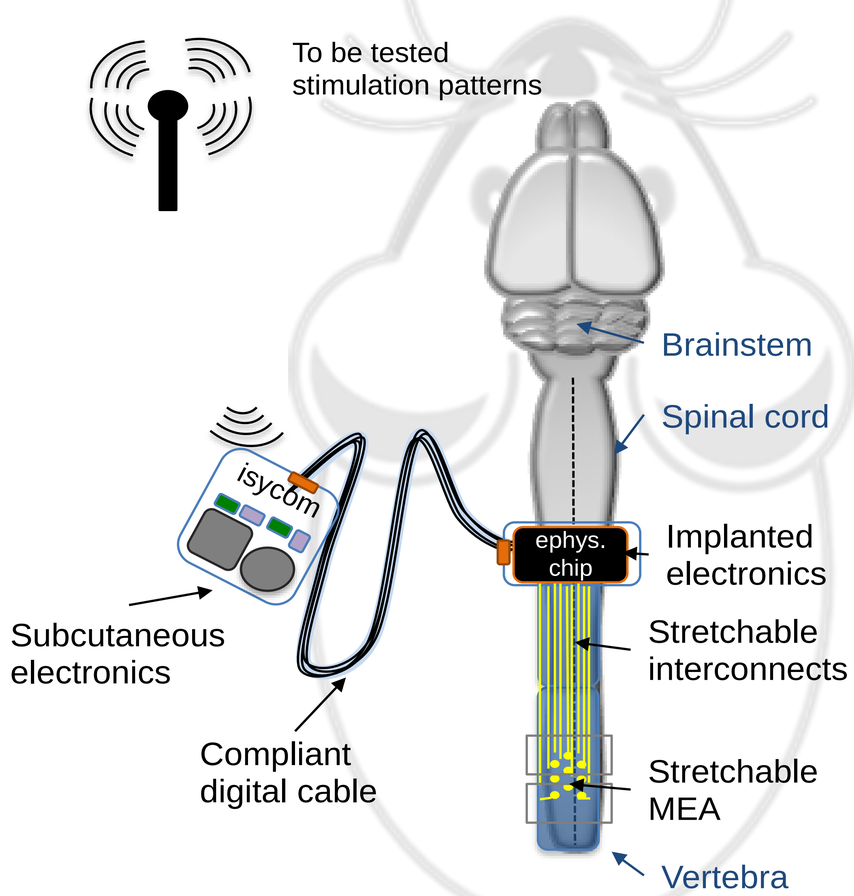
Context

Worldwide, an estimated 2.5 million people live with a chronic ***spinal cord injury*** (SCI), and more than half of them do not recover the ability to stand or walk with current therapeutic interventions.
Innovative neuroprosthesis technology combined with robotic training is a promising path to facilitate motor control and functional recovery after SCI.

Proposed research

An integrated spinal neuroprosthesis



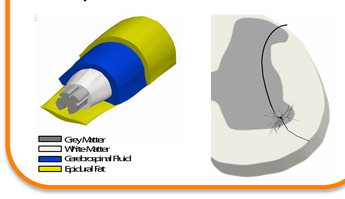
Schematic representation of the integrated spinal neuroprosthesis. The soft neural implant hosts ultra-compliant microelectrodes interfaced with miniaturised and power-efficient electronic circuitry linked to the digital and telemetry subcutaneous electronics board.

Mission

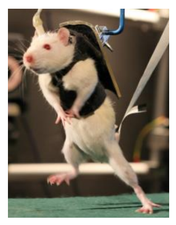
The SpineRepair mission is to develop and optimize the enabling technologies to implement a cutting-edge spinal cord neuroprosthesis. Prototypes of the novel integrated devices will be evaluated in SCI animal models. Our findings pave the way towards fundamentally new technological solutions and treatment paradigms to improve functional recovery in severely paralyzed individuals in a timely manner.

Technological advances

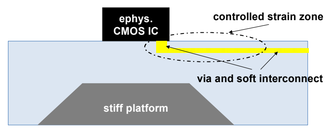
Hybrid computational model of epidural SC stimulation



Restoration of natural locomotor movements

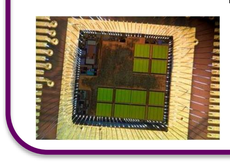


Hybrid integration of CMOS electronics and polymeric MEA



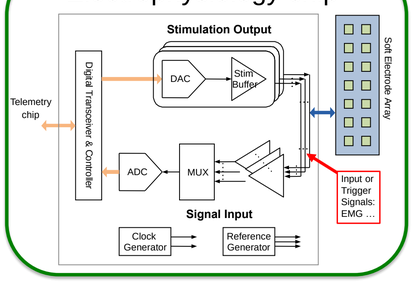
Lithography-compatible stretchable MEA

Power efficiency Wireless neuroprosthesis



Icycom 5x5mm^2

Electrophysiology chip



Interdisciplinary team

Experts at the forefront of research in ***nanomaterials***, ***biology*** and ***engineering.***
More than 8 PhD students and post-docs to be trained in the project.

Project outcomes

In technology

- nano-microfabrication of polymeric neural interfaces
- production and characterization of nanostructured materials
- hybrid integration of electronic devices with elastomeric based sensors
- design and realization of low-power integrated circuits and telemetry circuitry for neural implants
- models for *in vivo* restoration of sensorimotor functions after CNS disorders, especially spinal cord injury

Project impact

In the neural prosthetic community

•improve patients' quality of life
•significant impact on the prosthetic market
•further applications beyond spinal cord injury reaching an even wider industrial as well as patient community.

References:
van den Brand, R., J. Heutschi, et al. (2012). "Restoring Voluntary Control of Locomotion after Paralyzing Spinal Cord Injury." Science 336(6085): 1182-1185.