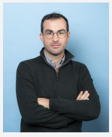
UPSIDE

July 2024

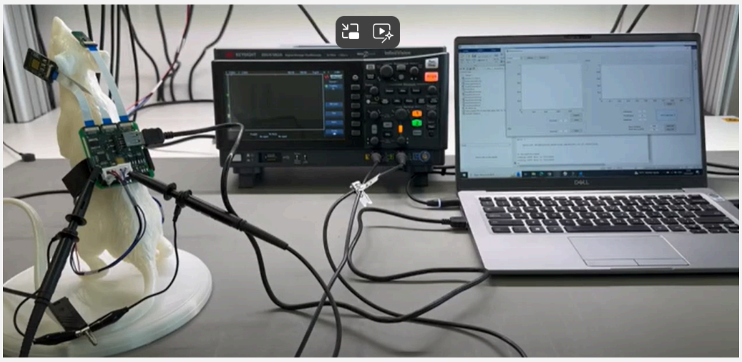
UPSIDE PROJECT INSIGHTS

Focused Ultrasound Personalized Therapy for the Treatment of Depression

"The UPSIDE project is dedicated to exploring ultrasound stimulation as a minimally invasive treatment for depression, offering an alternative to deep brain stimulation. Additionally, the project aims to develop advanced neuronal recording signal decoding tools to identify depression biomarkers for personalized therapy. We're excited to share the latest updates, **key results** and **deliverables** with our community in this newsletter."



Tiago Costa
Project Coordinator



1 Power Management Unit (PMU) Design

Objective: Develop a portable power management unit for the ultrasound stimulation system.

Achievements:

- Designed a PMU with five low dropout linear regulators, one boost DC-DC converter, and an ADC for temperature monitoring.
- Created a modular system to handle high current requirements, combining multiple PMUs on a single PCB.
- Validated the PMU design through Verilog and SPICE simulation, and successfully initiated production using TSMC 180nm BCD technology.

2 Ultrasound Brain Stimulation Electronics

Objective: Develop a compact electronic chip for focused ultrasound brain stimulation.

Achievements:

- Created a chip using high-performance CMOS technology capable of interfacing with over 1024 piezoelectric transducers.
- Ensured the chip's ability to produce highly reconfigurable waveforms and driving voltages, while minimizing power consumption.
- Developed the electronics to be deployable above the dura mater, suitable for pre-clinical experiments in rat models.

3 Epidural Electrical Recording Device (eREC)

Objective: Design a high-density, portable electrical recording device.

Achievements:

- Identified key specifications for the eREC, including power, area, noise, and channel count.
- Proposed a recording architecture focusing on minimal component footprint and power consumption.
- Developed a 64-channel prototype, with plans to scale up to 1024 channels.
- Anticipated validation of the eREC by August 2024, followed by experimental verification.

4 High-Density Neural Probes

Objective: Enhance neurophysiological data acquisition resolution and efficacy.

Achievements:

- Designed and fabricated two generations of polymer-based neural probes.
- Successfully recorded high-resolution local field potentials (LFPs) in vivo using first-generation probes.
- Improved electrode density in second-generation probes for higher resolution recordings.
- Established a scalable interconnection strategy, laying the groundwork for identifying neural biomarkers.

5 Behavioral Experiment Relay Station

Objective: Develop a miniaturized electronics board for controlling implantable devices in freely moving rats.

Achievements:

- Designed a relay station worn by rats as a backpack, capable of controlling ultrasound and electrical brain interfaces.
- Validated the system's implementation and demonstrated its use in real-time stimulation and brain activity monitoring.

6 Epidural Brain Interface (EBI) and Implantation Protocol

Objective: Create an implantable brain interface for focused ultrasound and cortical recording.

Achievements:

- Verified technical characteristics of commercially available FUS through various media tests.
- Established an implantation protocol for the EBI on rodents, considering physical constraints and animal welfare.
- Developed a prototype EBI and refined surgical methods for its implantation.
- Confirmed feasibility of maintaining chip contact with the brain surface, ensuring accurate targeting.

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Contact Us

Join us as we embark on a journey of discovery, learning, and growth. Stay curious, stay inspired, and let's innovate together!

www.project-upside.eu