Smart systems integration for biomedical and environmental applications

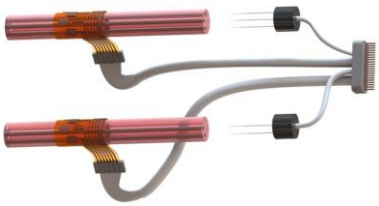
Implantable interfaces to dually link peripheral nerves with neural-based prostheses for control and feedback

NerveRepack

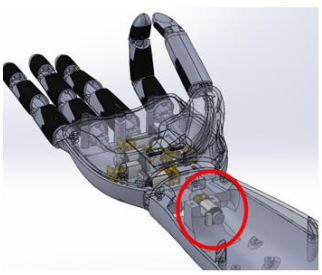
The primary goal of NerveRepack is to enhance mobility for individuals with amputated or paralyzed limbs.

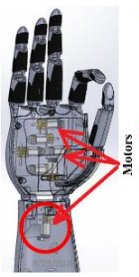
We aim to develop implantable neuronal interfaces that can transmit neuronal signals from the patient's nerves to exo-prostheses or exoskeletons, translating these signals into movements.

The system is designed to bidirectionally and selectively connect with exoprostheses and exoskeletons worn by patients with injured or damaged nerves.



The mechanical structure of the exoprosthesis will integrate sensors, actuators, electronics and batteries.





NerveRepack exoskeleton will be equipped with intelligent interfaces, pressure sensor arrays, movement algorithms and a bidirectional radio module for communication with the implantable neuronal system.

AMBITION:

- ❑ Design and fabricate innovative implantable neural interfaces that can bidirectionally communicate with prostheses and exoskeletons;
- ❑ New generation of implantable electrodes;
- ❑ Implantable module that with radio communication;
- ❑ Mechatronic structure for two exo-skeletons;
- ❑ Exoprothesis mechatronic structure;
- ❑ Electronic systems for the exo-prothesis and exoskeletons control system, data communication, power management;
- ❑ Dedicated ASIC for the implantable module;
- ❑ Employ highly biocompatible materials for encapsulation;
- ❑ ***In vivo*** validation of the neural systems.

Co-funded by the European Union

Chips JU

Portable platform for air monitoring, with self-powered ultra-sensitive sensors array and AI-based detection

NET4Air

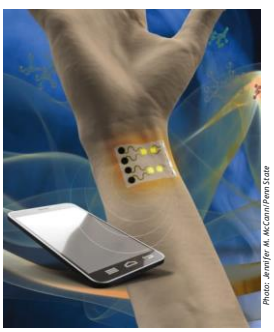
One of the main objectives of the NET4Air project is to build a sustainable research community among the partners, fostering regional excellence in the field of sensors, monitoring practices and AI for data processing of air quality measurements. To achieve this, a research project addressing multiple instances of air pollution will be run over the length of the project.

Sensing devices for air monitoring in NET4Air will be redesigned for **miniaturization, reduced power consumption, green, autonomous functioning and increased sensitivity** using customized sensitive layers (CNTs, Graphene, conductive polymers, metal oxides, and different dopants). We are proposing the development and building of miniaturized, precise, and low-cost sensors and smart sensing systems using nanoelectronic technology and infrastructures.

Data processing and machine learning algorithms will be used to overcome know issues of gas sensors selectivity.

The platform will initially include a 10 sensors array, each one being selective to a specific gas. The sensor substrate is silicon, plastic, or ceramic. The sensitive materials include carbon-based materials (CNT, graphene), conductive polymers, metal oxides, with modified parameters (e.g., thickness, conductivity).

The platform will be reconfigurable, and widely implementable in different applications: citizens living in big, polluted cities, patients with medical issues related to air quality (asthma, allergies, heart diseases), indoor gas monitoring (explosive, pollutant) for usage in industry, houses, offices and greenhouse gas monitoring.



AMBITION:

- ❑ Design and fabricate a modular array-based sensing systems for the precise and selective monitoring of pollutant combinations in differing environments;
- ❑ Identify new sensing layers for the detection of polluting gasses;
- ❑ Develop analysis algorithms for increasing the selectivity of multi-sensor array platforms;
- ❑ Explore distribution of pollutants in select locations using the miniaturized sensing platforms and analyze their spatial and temporal distribution.

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