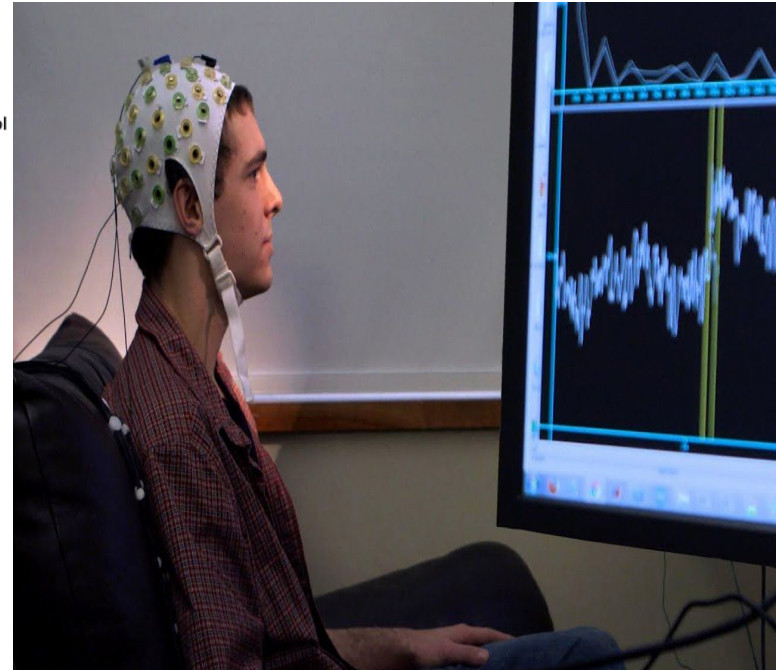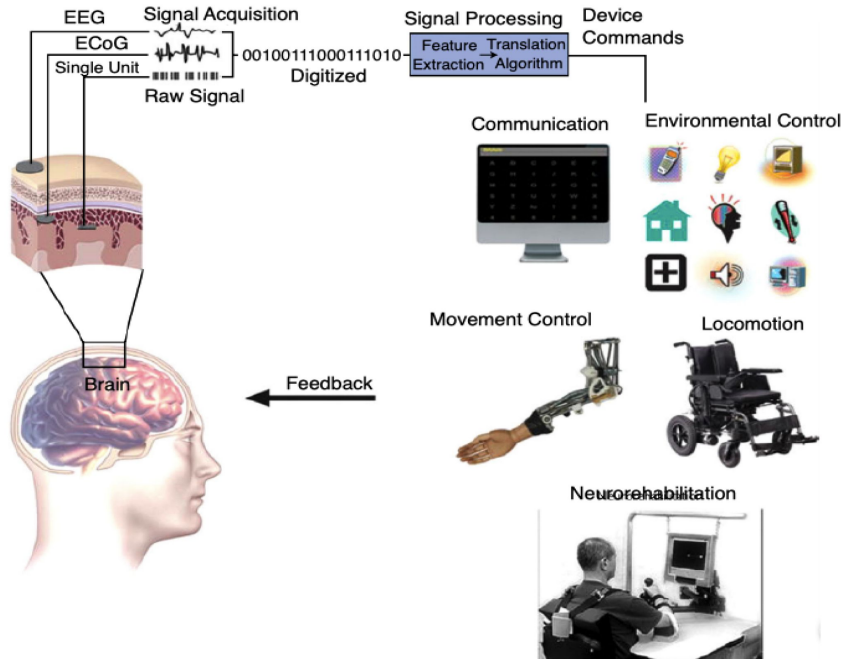# Computer Brain Interface

Research Methodology and Reproducible Research

José Rodolfo Mondragón Zenteno

Introduction

A brain–computer interface (BCI), is a direct communication link between the brain's electrical activity and an external device, most commonly a computer or robotic limb.
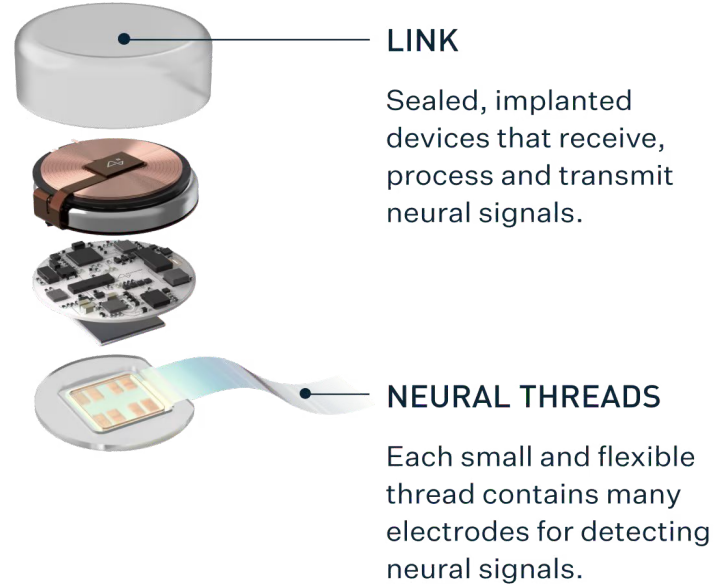
Challange

- *"To identify markers which factor in the unique nature of people's brains" that could allow to control a system with the BCI* ~ Marie-Constance Corsi
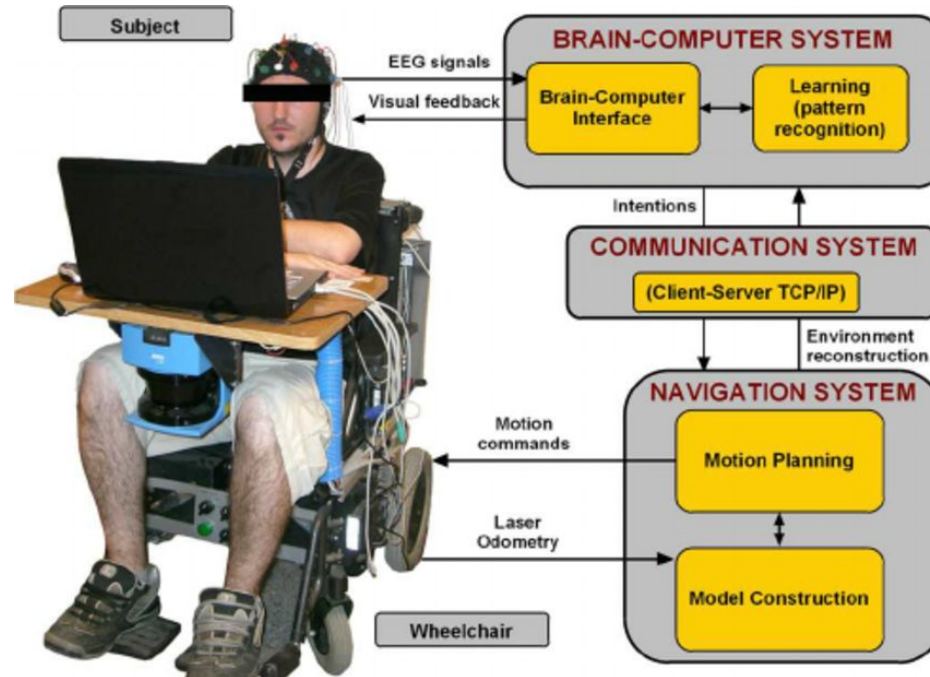
Neuralink

Devices to treat serious brain diseases in the short term, with the eventual goal of human enhancement.

LINK

Sealed, implanted devices that receive, process and transmit neural signals.

NEURAL THREADS

Each small and flexible thread contains many electrodes for detecting neural signals.
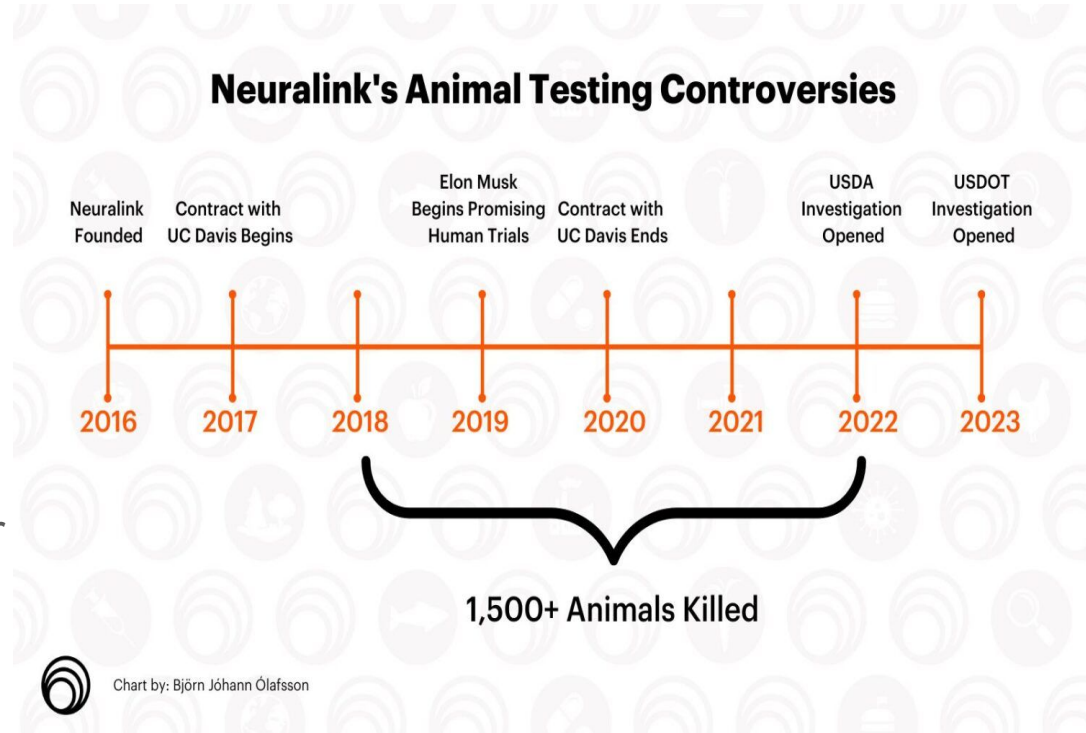
Neuralink

- In 2024, the first human trial was carried out.
  - The quadriplegic subject was able to move a cursor on a computer screen

- Second human trial.
 - Able to use CAD software and play 1st person videogames

Limitations

- Data compression and transmission

- Safety and health concerns

- Brain morphology changes

- Overestimated results (similar ones achieved years ago)

Neuralink's Animal Testing Controversies

| Neuralink Founded | Contract with UC Davis Begins | | Elon Musk Begins Promising Human Trials | Contract with UC Davis Ends | | USDA Investigation Opened | USDOT Investigation Opened |

2016   2017   2018   2019   2020   2021   2022   2023

1,500+ Animals Killed

Chart by: Björn Jóhann Ólafsson

NERV

An EEG based system for post-stroke functional rehabilitation to increase recovery probability.
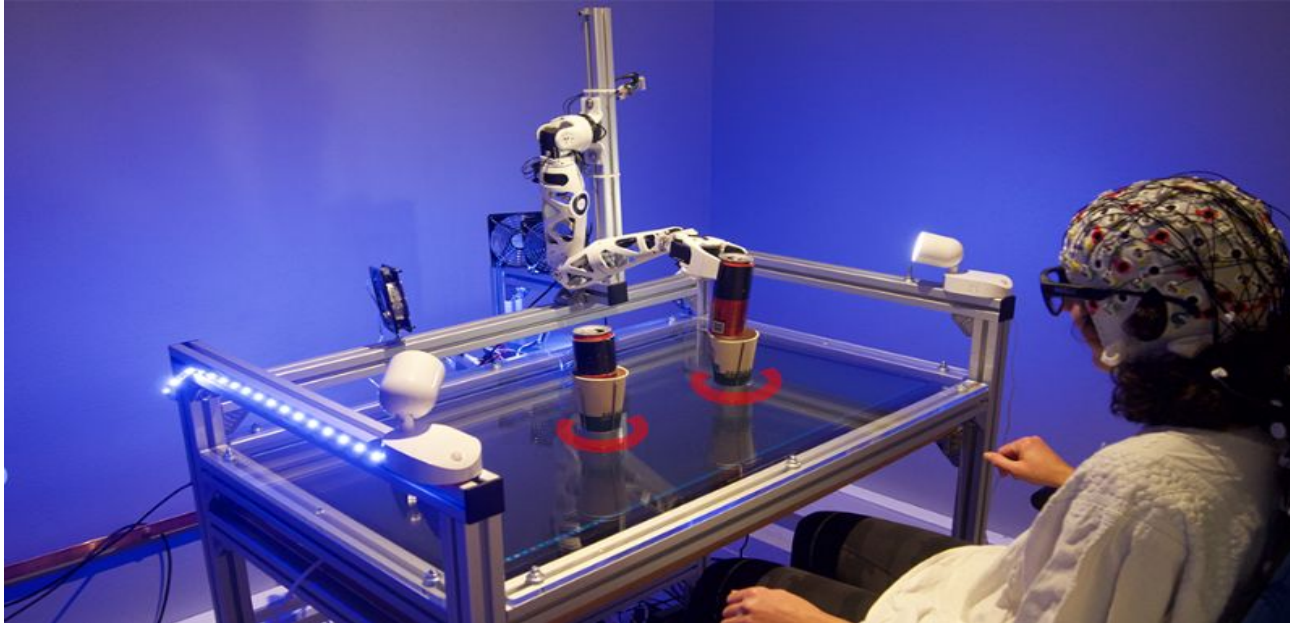
NERV

- Better data makes better results
  - Novel deep study of the brain signals interaction as a network

  - Enhancing data quality to improve current algorithms performance

  - Usage of contextualized data on the brain's interaction concept drift .
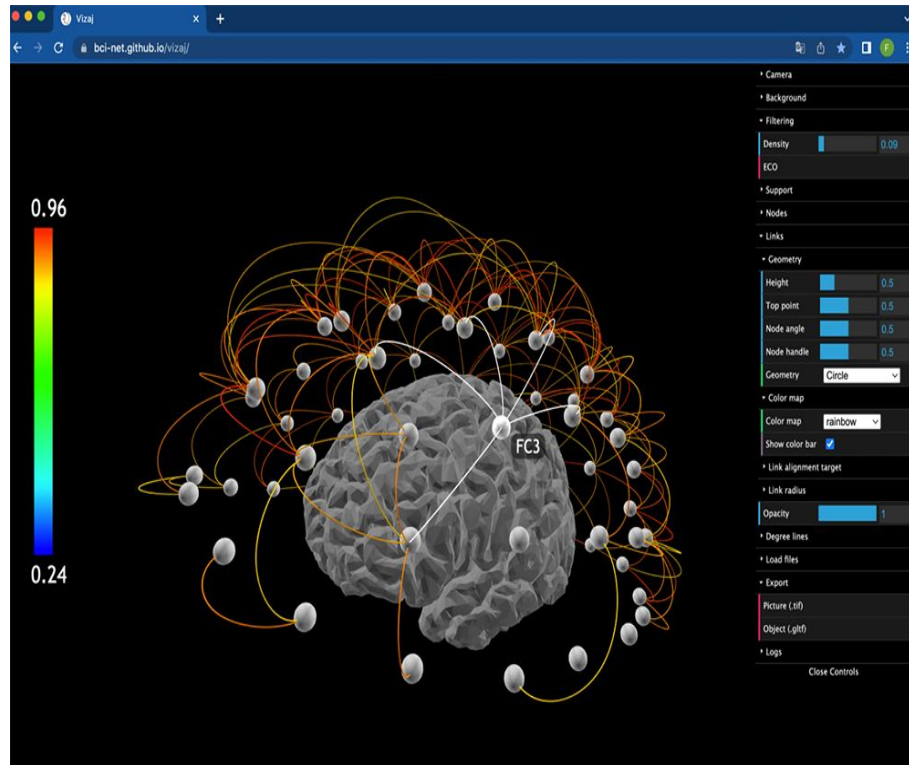
Limitations

- EEG captures noisy and unstable signals

- Brain wave behavior is different between individuals

- Concept drift learning remains an open problem in ML

- Precise EEG equipment is costly and not ment for consumer

Pros and Cons

- Pros
    - Enhance the life quality of reduced-mobility people
    - Achieve an "effortless" user-computer interaction
    - Increase the post-stroke recovery possibilities

- Cons
    - Invasive procedures with safety concerns for health
    - Low accessibility technology
    - Questionable animal testing
    - Private industry in control (privacy issues, extend of human-modification, social inequality…)

ADEME Scenario

These technologies may fall into the Restoration Gamble and/or Green Energies.

- BCIs implemented for energetically efficient manipulation of systems and social healthcare

- Technologies requiere deep research and private investment/resources

GREEN TECHNOLOGIES

RESTORATION GAMBLE