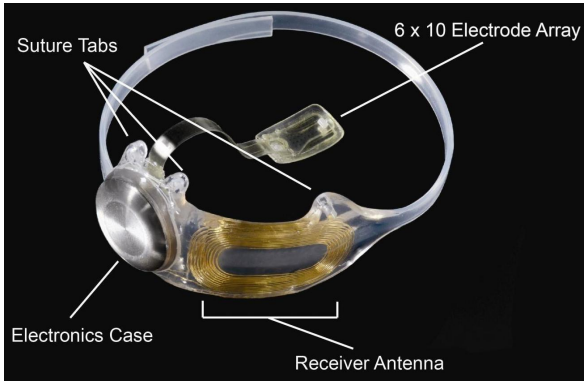
Restoration Mindware

Green Flamingos featuring: Alexa, Ana, Amber, Jonathan, Bailey, Danny

BMI- Brain-Machine Interfaces



Intersection of neuroscience and engineering : why?

Converting the biological system into a mechanical/electrical system (modeling a neural network as a electrical circuit)

Connects the biological structure of the brain to mechanical/electrical structures (ex: using output of motor cortex to control a robotic arm)

Example: Overriding photoreceptors in the retina with a retinal implant to help the blind see

Monkeys Learn to Steer Wheelchair

A mobile robotic wheelChair, which seats a monkey, was moved from one of the three starting locations to a grape dispenser. The wireless recording system records the spiking activities from the monkey's head stage, and sends the activities to the wireless receiver to decode the wheelchair movement.

Monkeys Drive Wheelchairs Using Only Their Thoughts

https://youtu.be/vktmg2ANtl8

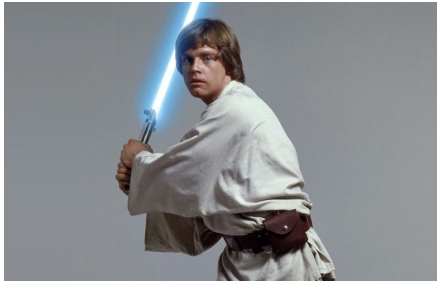
Monkey-Machine Interface

Past: patients control only 1 robotic limb with brain

Now: rheus monkeys can preform movements with 2 robotic arms using BMI

How: scientists implanted hundreds of tiny electrodes into the brain of the two monkeys, allowing them to control reaching movements of their onscreen avatar

Defense Advanced Research Projects Agency (DARPA) 2006-Present



- Military Funded
- DARPA's mission:
  - to make seminal investments in advanced technologies that can have outsized impacts on national security and help those who have stepped up to serve our nation
- Controlled by skin-surface-attached myoelectric sensors
- Johnny Matheny (2009): Guinne Pig of DARPA
  - muscle re-innovation surgery->moved the nerves that controlled his missing limb into muscles stump
- "LUKE" (JULY 4th, 2017): Life Under Kinetic Evolution
  - Enables dexterous arm and hand movement through simple control system
    - Allows users to control multiple joints simultaneously

This is Ian.

- Implanted electrode array in Burkhart's brain-motor cortex
- Machine learning algorithms to decode brain activity
- Stimulate a sleeve of 130 electrodes on his forearm
- 3 sessions weekly for 15 months post implant

Why is this important?

Article: Neuroprosthesis Restores Arm Movement

➢ “Neural bypass” between brain & muscles

Perform daily activities like:

- Picking up a glass
- Pouring liquid and stirring it

“This study marks the first time that a person living with paralysis has regained [natural] movement by using signals recorded from within the brain” - coauthor Chad Bouton, Feinstein Institute for Medical Research in Manhasset, NY

Who’s next?

Jan Scheuermann

With a degenerative disease that progressively severed connections between her brain and muscles.

And After Jan?

Juliano Pinto

At the start of the 2014 World Cup, a paralyzed from the waist down man took the first kick by controlling a robotic leg with his mind.

Now that BCI Exoskeletons exist, what are we going to do with them?

Let’s race them.

Uses of BCI exoskeletons

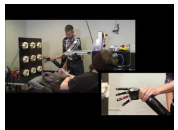
1. ReWalk exoskeleton; enable those with lower limb disabilities
2. The Hulc; enables soldiers to carry 90kg of weight on the feild
3. Powerloaders; lift a total of 100kg & walk at 5mph as a factory floor worker
4. Cyberdyne; assistive limbs designed for “back load reduction” in the work place
5. Raytheon; US gov. second gen. Hulc lifting heavy objects 17:1
6. Lokomat; designed to help stroke patients improve their walking
7. Keeping older people active and healthy longer
8. Beneficial for people with degenerative/ neurological diseases

Grasping Concepts

- Somatosensory Cortex deals with touch
- Touch controls manipulation of objects
- Prosthetic limbs

Feeling without Touch

- Nathan paralyzed from the chest down
- Electrodes in somatosensory cortex
- Better manipulation of prosthetics



Ethical Considerations

Informed Consent

- for initial participation
- decisions about life-sustaining treatment
    - mental/emotional capacity

Expectations

- psychological harm
- cognitive capacity for planning could be impaired
- discriminate on basis of level of cognitive function?

Mind-Reading

- Privacy
  - brands/marketing
  - identity theft
  - interrogation
  - vulnerabilities

Enhancement

- fairness
- coercion
    - pressure to keep up

Self-Image

- authenticity
- humanity
    - dualism v materialism

Do Androids Dream of Electric Sheep?

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