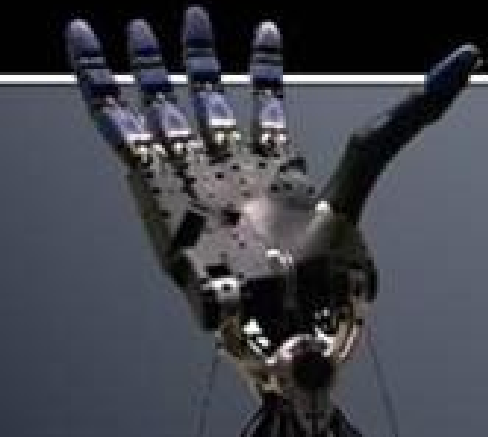
BRAIN

COMPUTER



INTERFACE

Outline

- What is Brain Computer Interface (BCI)
- Tools in BCI
- BCI today
- Future of BCI
- Ethical Issues in BCI

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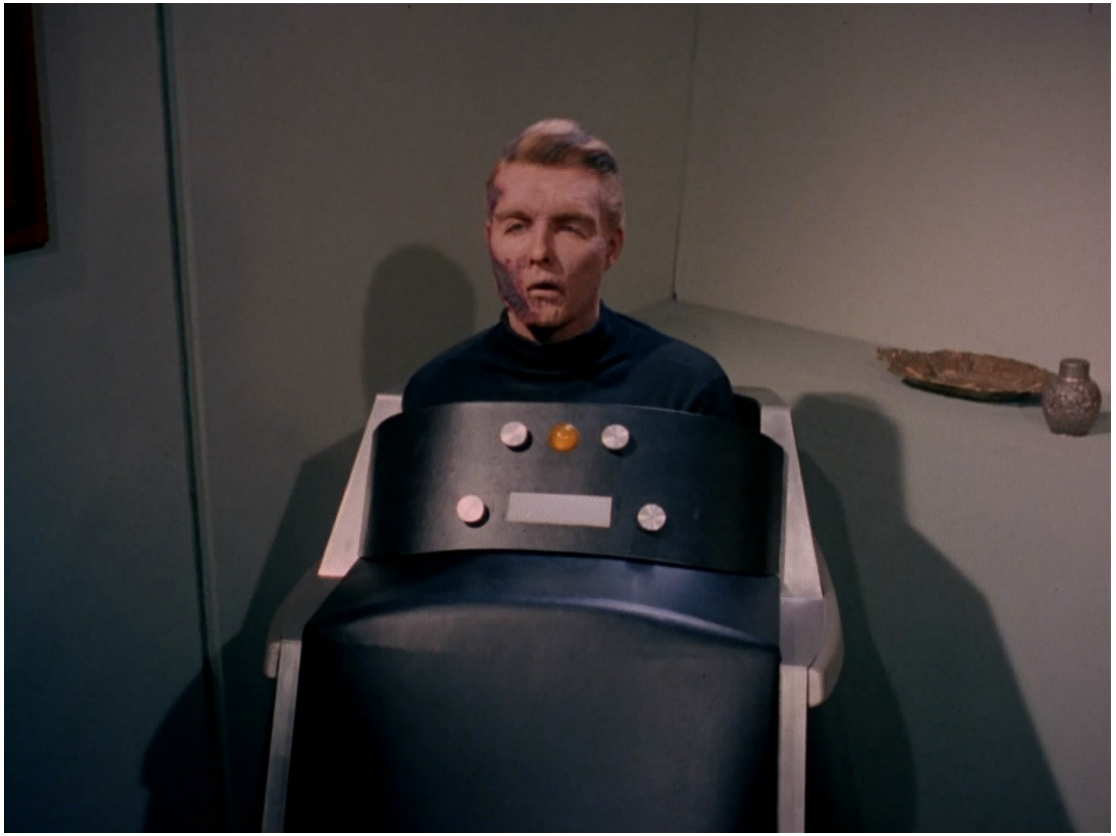
Science-fiction 1960s



2012 (Cathy Hutchinson)

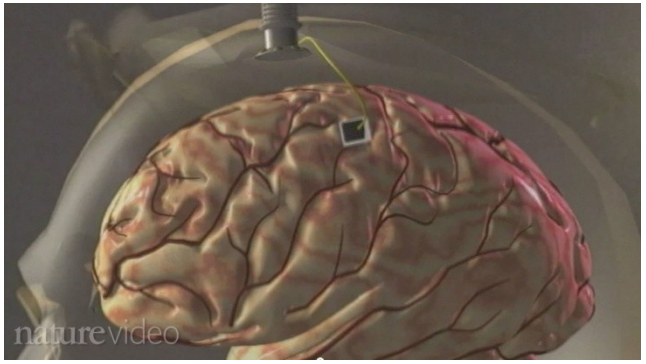
- Movie: https://www.youtube.com/watch?v=ogBX18maUiM

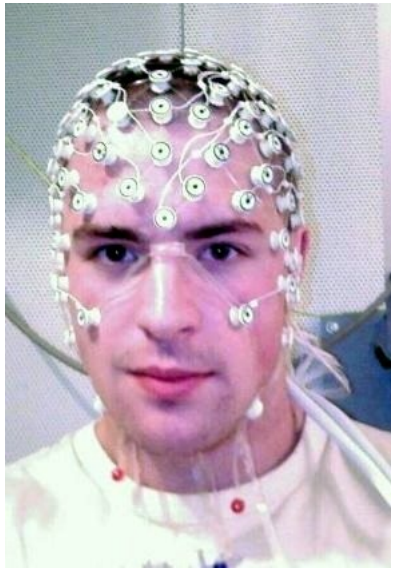
What is Brain Computer Interface?

A system for either reading out the information from the brain to be translated by a computer to motor commands or simple acts of communication,

Or

systems for brining information into the brain in a way that enables the equivalent of sensations or perception


naturevideo

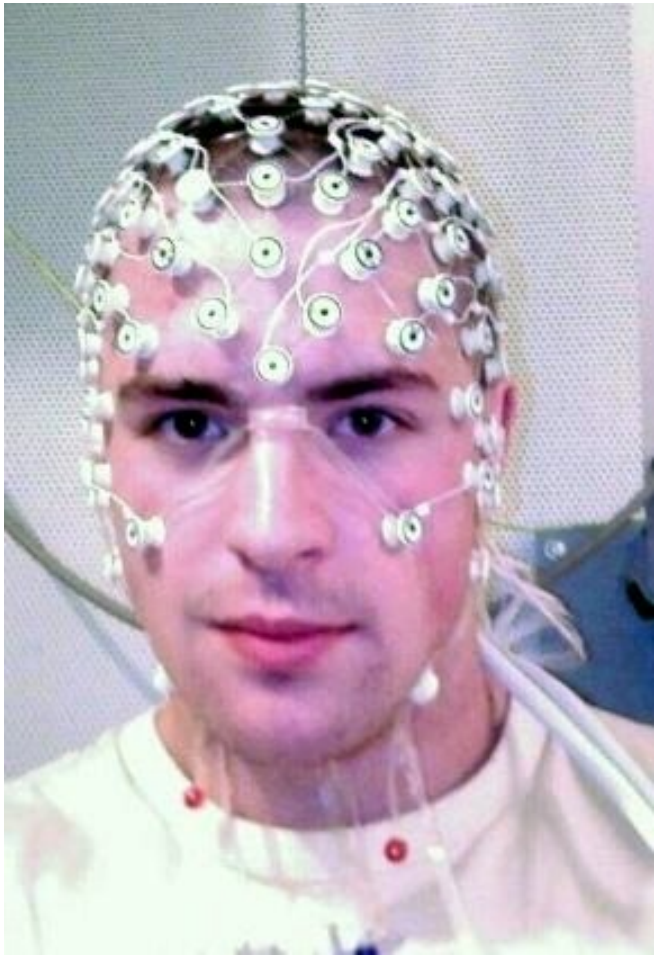


Outline

- What is Brain Computer Interface
- Tools in BCI
  - EEG
  - ECOG
  - TMS
- BCI today
- Future of BCI
- Ethical Issues

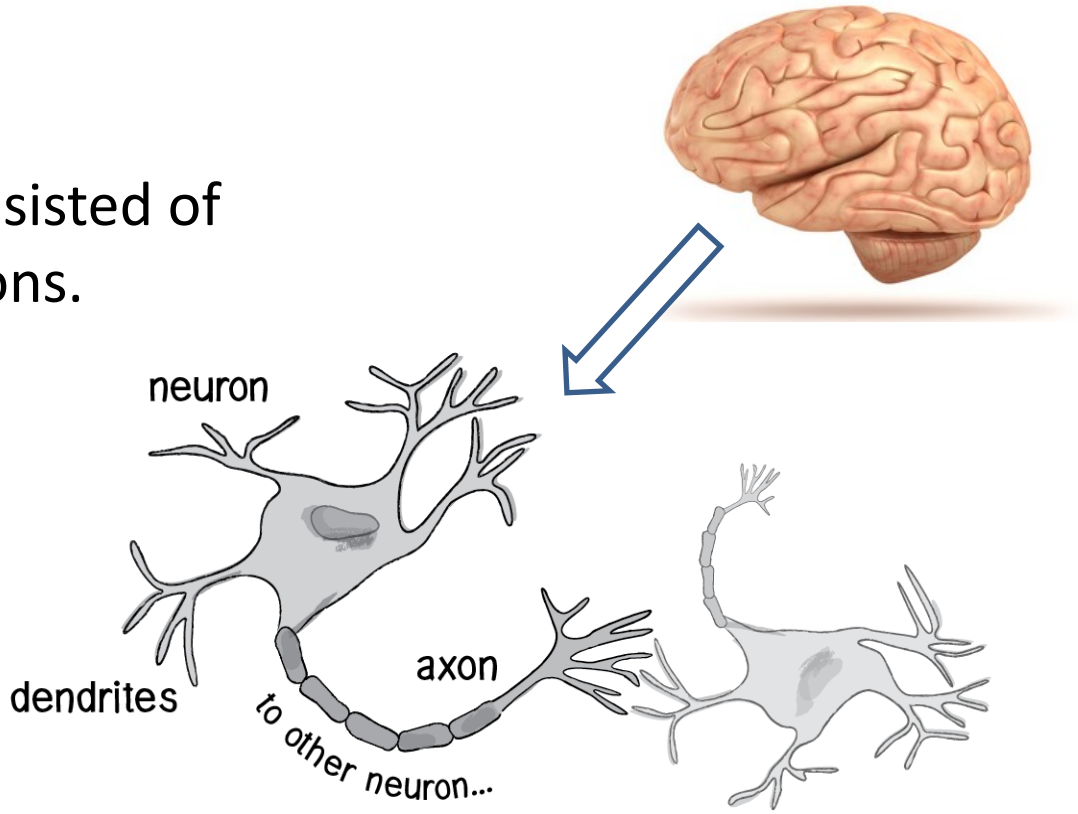
electroencephalogram (EEG)

An electroencephalogram (**EEG**) is a test that detects electrical activity in your brain using small, flat metal discs (electrodes) attached to your scalp.



What EEG is recording?

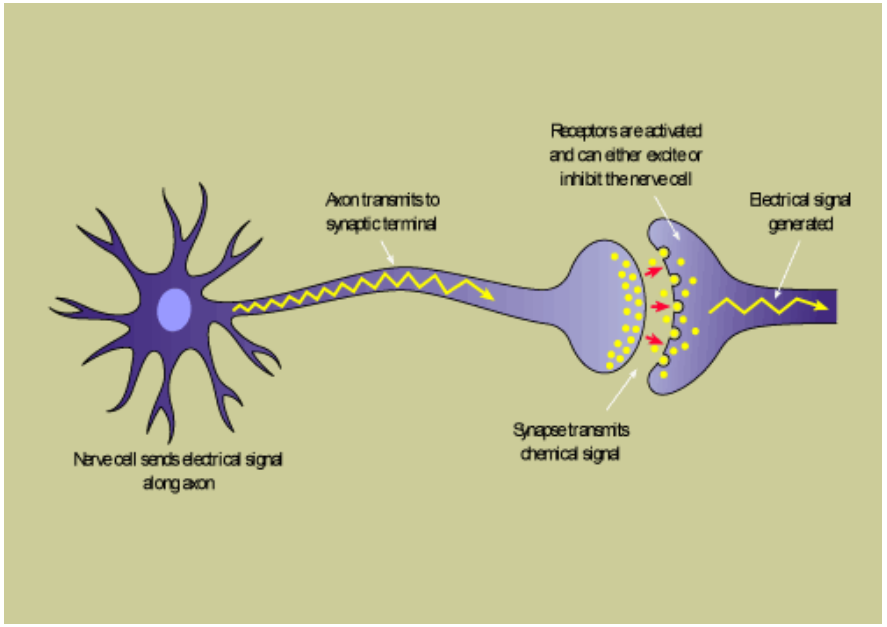
The brain is consisted of million of neurons.



They connected to each other and form networks.

What EEG is recording?

- They communicate are through electrical signals.



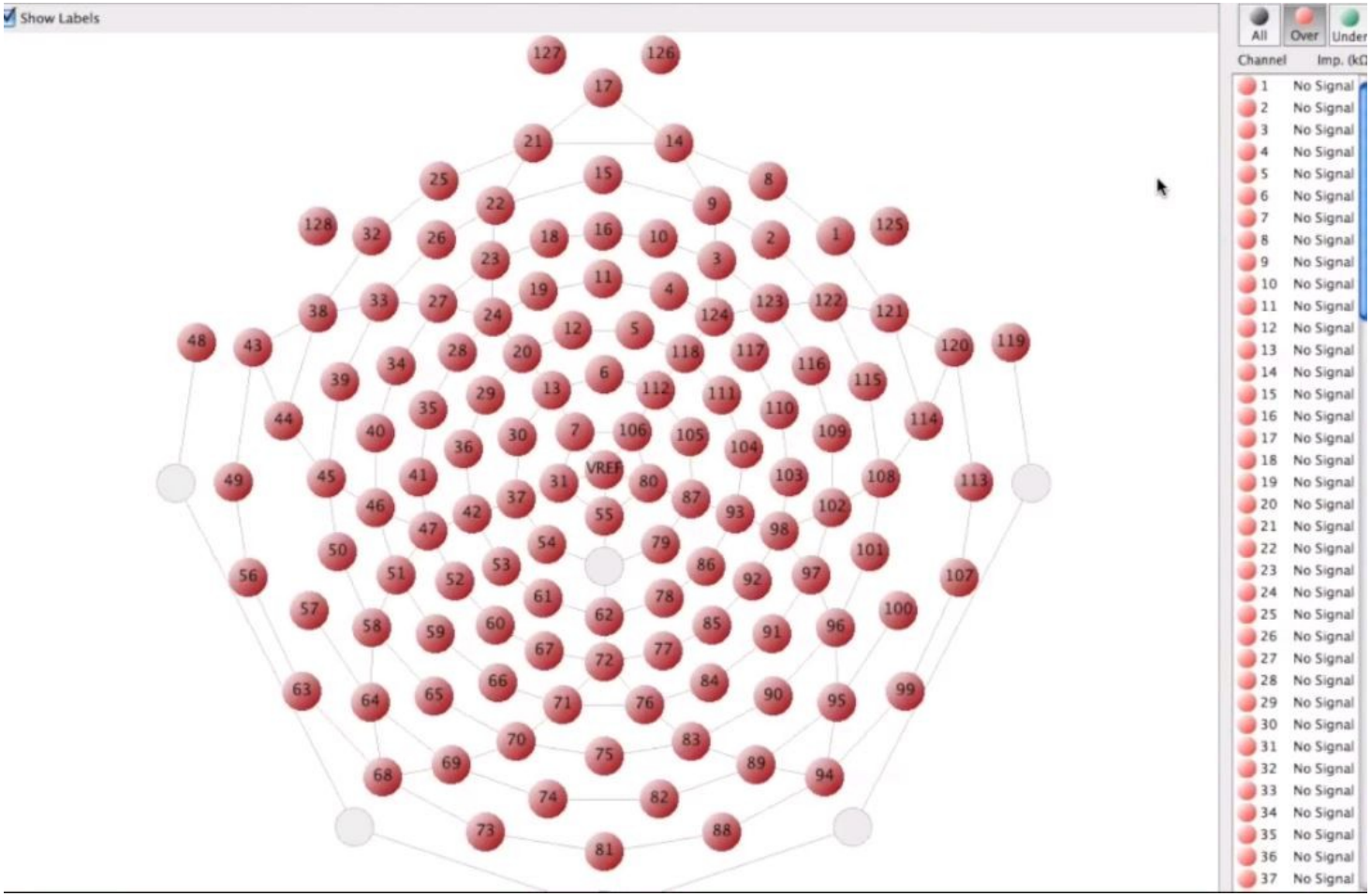
- The electrical signals

- The electrical activity of one neuron is too small, but we can record the electrical activity of tens of thousands of neurons

What Equipments are used to capture these EEG signals?

electrode cap

EEG amplifier


Show Labels
All
Over
Under
Channel
Imp. (kΩ
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3 No Signal
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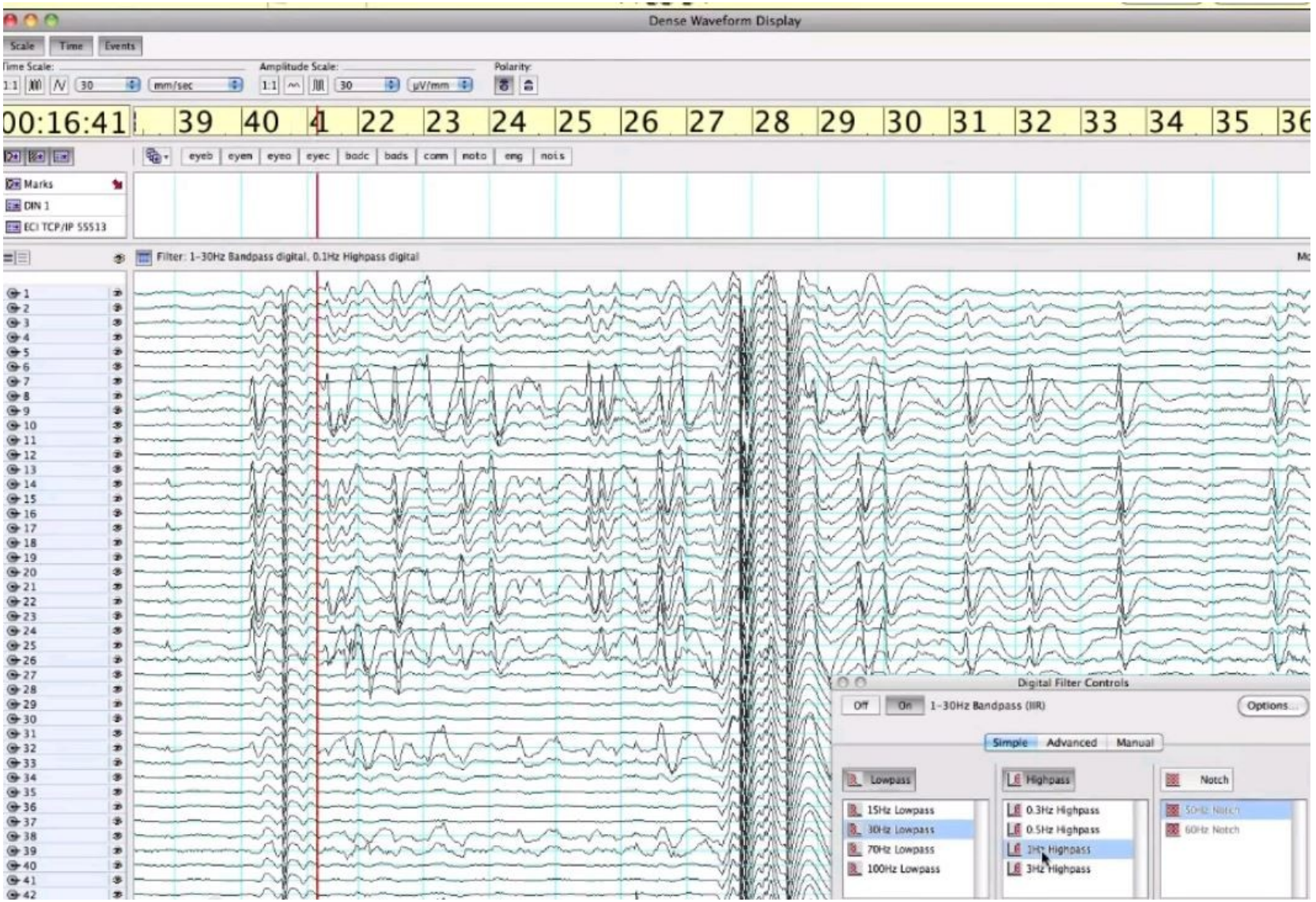
VREF

EEG Data


Dense Waveform Display
Scale
Time
Events
Time Scale:
Amplitude Scale:
Polarity:
mm/sec
µV/mm
00:16:41
39
40
41
22
23
24
25
26
27
28
29
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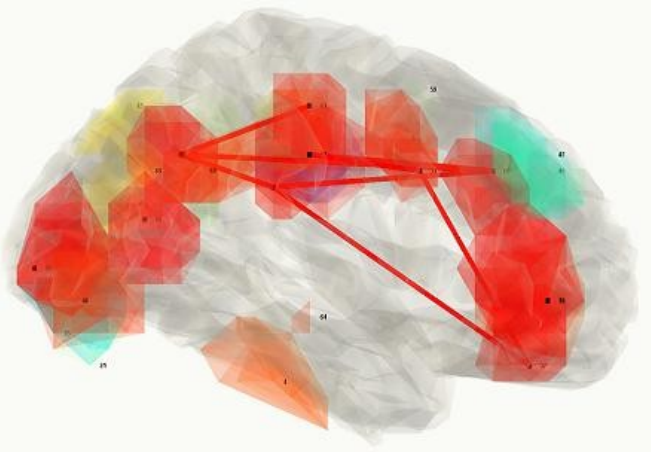
31
32
33
34
35
36
eyeb
eyem
eyeo
eyec
badc
bads
comm
moto
emg
nois
Marks
DIN 1
ECI TCP/IP 55513
Filter: 1-30Hz Bandpass digital, 0.1Hz Highpass digital
Digital Filter Controls
Off
On
1-30Hz Bandpass (IIR)
Options...
Simple
Advanced
Manual
Lowpass
Highpass
Notch
15Hz Lowpass
30Hz Lowpass
70Hz Lowpass
100Hz Lowpass
0.3Hz Highpass
0.5Hz Highpass
1Hz Highpass
3Hz Highpass
50Hz Notch
60Hz Notch

Benefits of EEG

- Fast (Records in the order of Milliseconds)
- Safe (It passively records the signals)
- No Surgery

Weakness of EEG



Poor Spatial Resolution (Doesn’t present where exactly the signals come from)

Weakness of EEG

How to overcome this weakness?

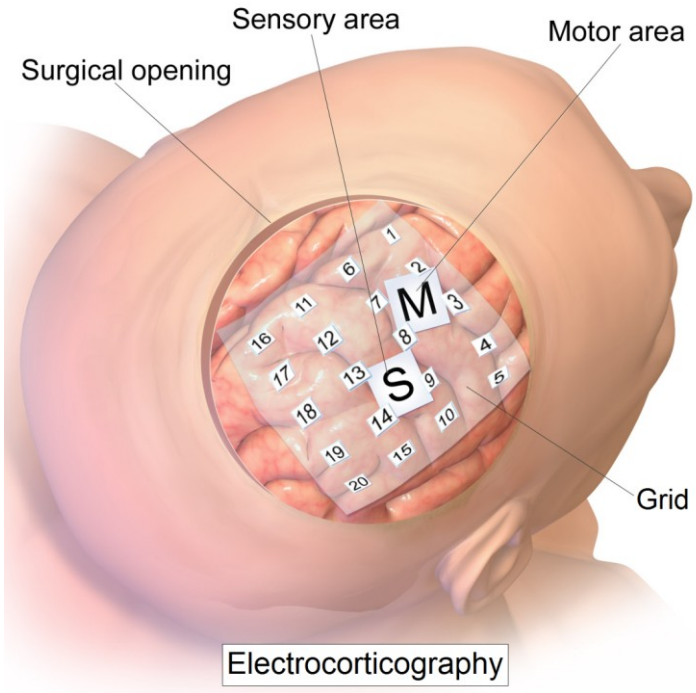
Poor Spatial Resolution (Doesn’t present where exactly the signals come from)

Outline

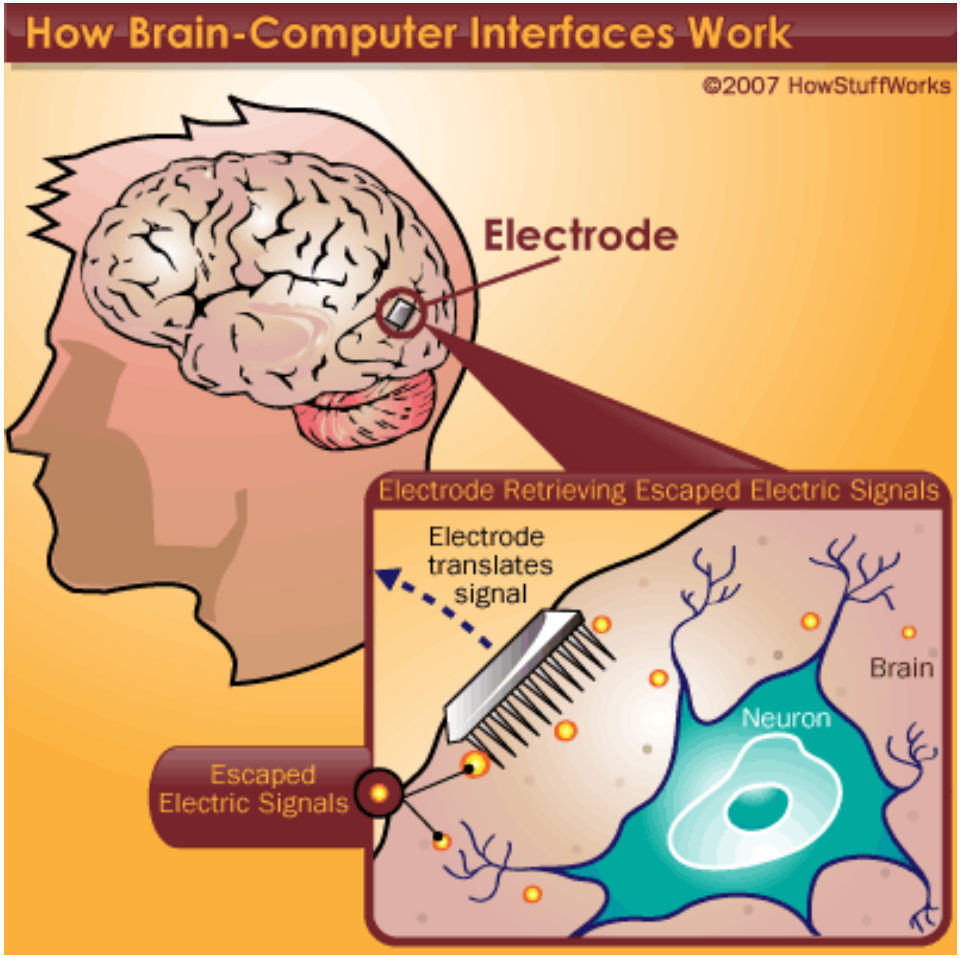
- What is Brain Computer Interface
- Tools in BCI
  - EEG
  - ECOG
  - TMS
- BCI today
- Future
- Ethical Issues

Electrocorticography (ECoG)

Electrocorticography (ECoG) is the practice of using electrodes placed directly on the exposed surface of the brain to record electrical activity from the cerebral cortex.



Implanted Electrodes



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TMS
(Transacranial Magnetic Stimulation)

TMS is a magnetic field generator.

It produces small electrical currents in the region of the brain just under the generator via electromagnetic induction.

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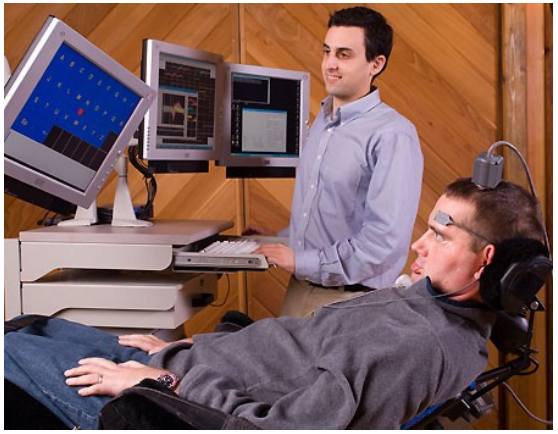
Helping paralyzed people

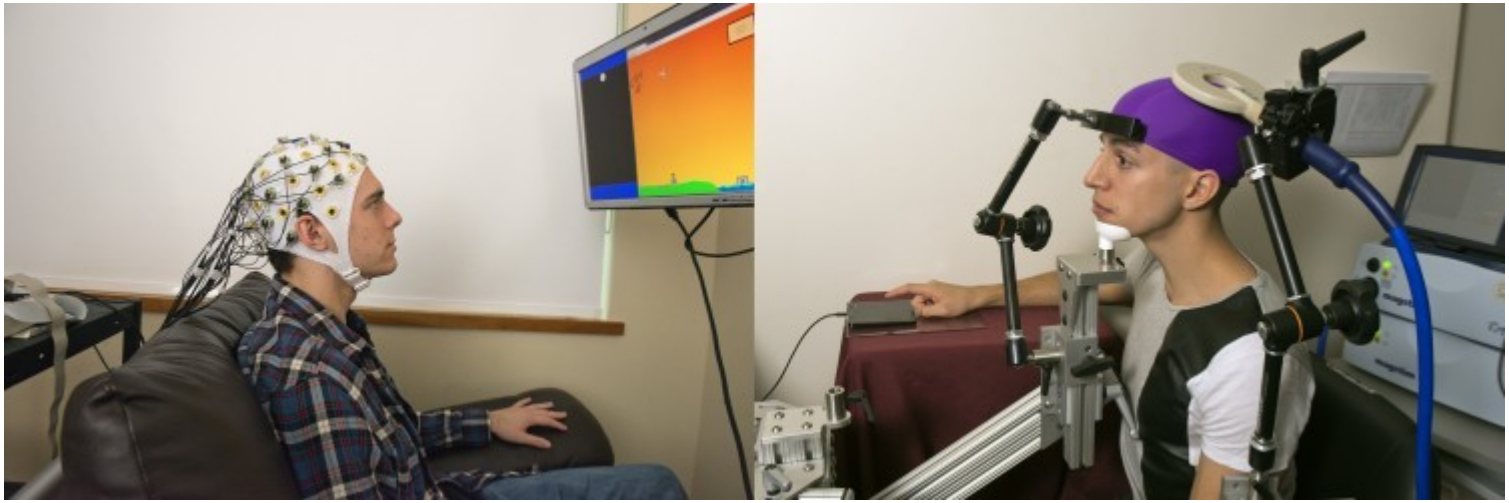


Interface between computer and nervous system

Kevin Warwick in 1998 put a direct interfaces between computer systems and the his nervous system.

Brain to Brain communication

- University of Washington, Communicate by thought signals alone



Brain to Brain communication

- Movie:
- https://www.youtube.com/watch?v=K3rwDxSJQ7o
- http://www.dailymail.co.uk/sciencetech/article-2403851/Brain-brain-interface-allows-researcher-control-colleagues-hand-internet.html#v-2634307785001

Monkey with a robotic arm

- Movie:

https://www.youtube.com/watch?v=wxIgdOlT2cY

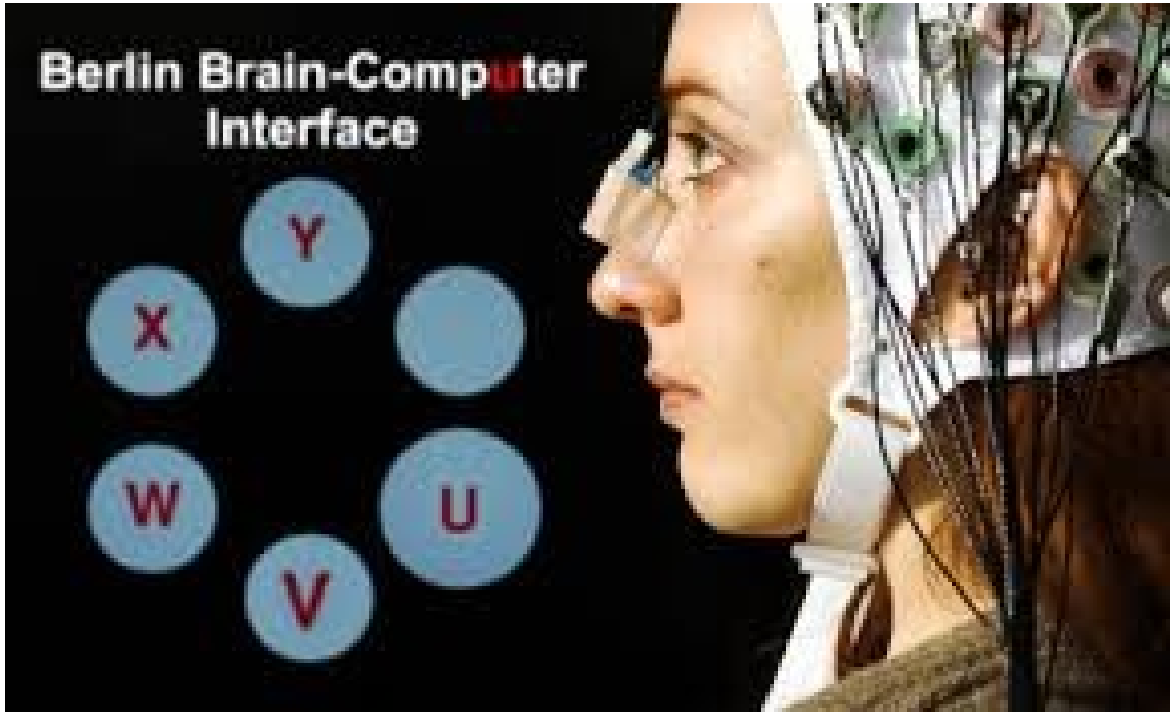
Emotive EEG signal reading

A company now is providing EEG caps for a reasonable price

There are application on iphone for using these caps

Playing games without hands

Typing without hands



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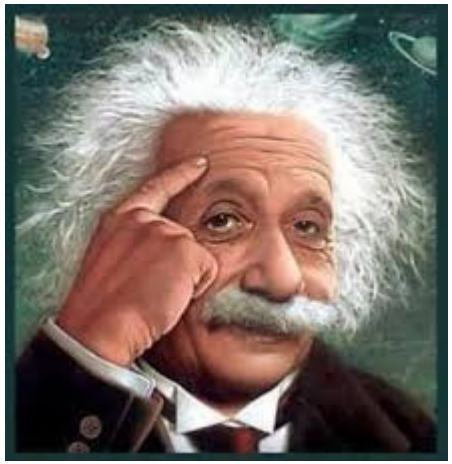
Future of BCI

- Humans who advantage from computer directly.
  - Rapid math
  - Call on Internet knowledge rapidly
  - Increased memory



Future of BCI

- Advancing the technology for helping paralyzed people

Future of BCI

- Helping blind people to see

Future of BCI

- Enhance human vision and let them to see wavelengths that is not visible with eyes

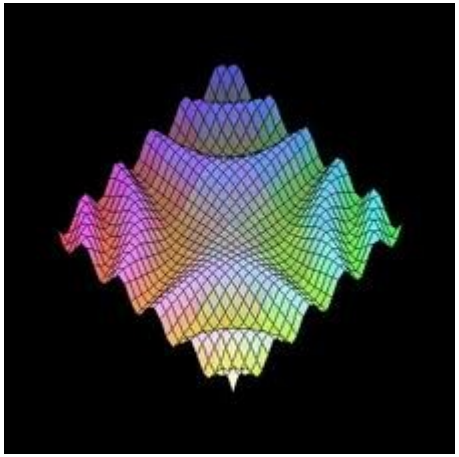
Future of BCI

- Humans with artificial limbs

Future of BCI

- Perceiving things that are not normally possible:

  Understanding multi-diementiality



Future of BCI

- Memories of what you haven’t experience
- Upload somebody else’s memory to yours

Outline

- What is Brain Computer Interface
- Tools use in BCI
- Applications
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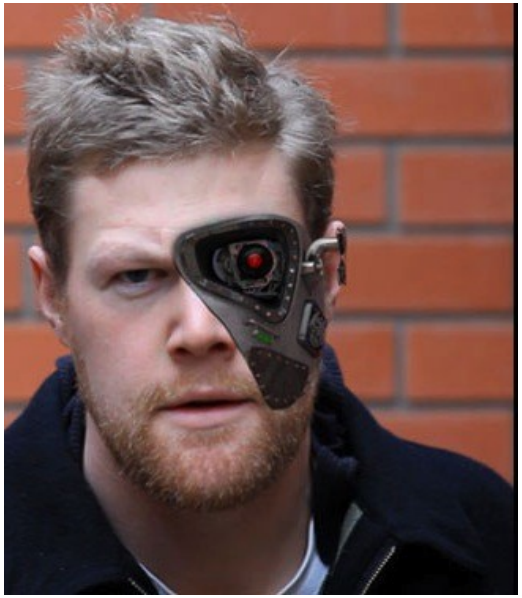
- Ethical Issues

Problems and Ethical issues

- How humanity will change?
- (Trans-humanisem)

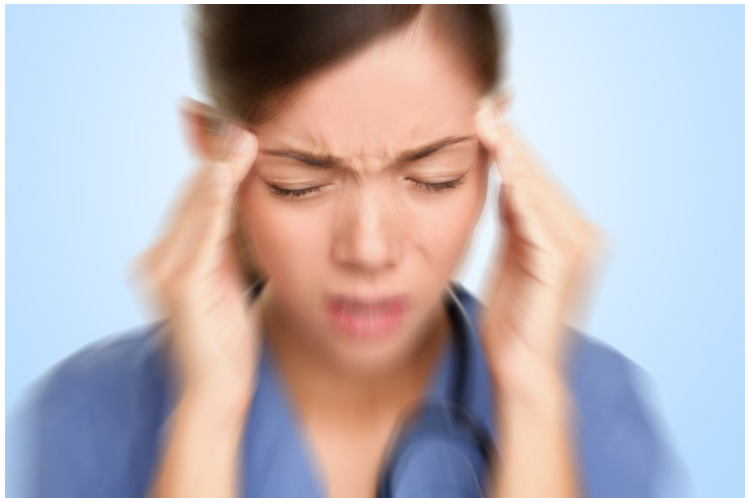


Problems and Ethical issues

- Enhance the power of humans

Problems and Ethical issues

- If BCI stop working or send wrong signals



Problems and Ethical issues

- Hack the brain

Summary

- BCI research has succeeded in its initial goal: proving that It is useful for paralyzed people
- BCIs are gaining attention for healthy users and new goals are defined
- Many ethical issues will emerge as BCI research advances that should be considered