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 \textit{from} the brain to be translated by a computer to motor commands or simple acts of communication,

\textbf{Or}

systems for bringing information \textit{into} the brain in a way that enables the equivalent of sensations or perception.
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• What is Brain Computer Interface
• Tools in BCI
  – EEG
  – ECOG
  – TMS
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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?

- EEG amplifier
- Electrode cap
- Laptop
EEG Data
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)
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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.
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=K3rwDxS JQ7o
  - 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=wxIgdOiT2cY
Emotive EEG signal reading

A company now is providing EEG caps for a reasonable price.

There are applications 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-dimensionality
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
• Future
• Ethical Issues
Problems and Ethical issues

• How humanity will change?
• (Trans-humanism)
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.