A Brief Introduction to Non-Invasive Brain-Computer Interfaces

Elliott Forney

Colorado State University
Brain-Computer Interfaces Group

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Brain-Computer Interfaces

- Brain-Computer Interface (BCI)
- Direct communication between brain and machine
- Bypasses innate motor-based means of communication
- Control a computerized device using only thoughts
- Voluntary changes in mental state, not mind reading!
- Uses patterns associated with mental cues
Uses for BCI

- BCI have many potential uses
- Reestablish communication with people who are Locked-in
  - Aware but unable to communicate, e.g., ALS
- Assistive technology
  - electric wheelchairs, computers, environmental controls
- Rehabilitation
  - learning to rewire parts of the brain
- input devices, video games, monitoring emotions
Electroencephalography (EEG) to measure brain activity

- Non-invasive, portable, relatively inexpensive
- Superficial & noisy signals
Machine Learning algorithms identify patterns in EEG

This can be very difficult because:

- different for each person
- change over time
- noise & artifacts
- the brain is complex!
Synchronous BCI

- Synchronous BCI use patterns associated with external stimuli
- P300 speller is an example
- User looks for a specific character in a series or grid of flashing characters
Asynchronous BCI

- Asynchronous BCI do not require external stimuli
- Mental Tasks is an example
- Imagine left arm moving moves to the left while silently singing a song moves to the right
The field of BCI is still in its infancy

Explosion of BCI research in recent years

Some people now rely on BCI

Several companies are working on commercial products

Personal predictions:
- 5 years: commercial synchronous BCI available
- 10–20 years: commercial asynchronous BCI available
- within our lifetimes: BCI will be commonplace
Thanks!

"THE COMPUTER SAYS I NEED TO UPGRADE MY BRAIN TO BE COMPATIBLE WITH ITS NEW SOFTWARE."