

**Shaping the new human-technology frontier:
Controlling objects using signals
emanating from a human brain**

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Overview

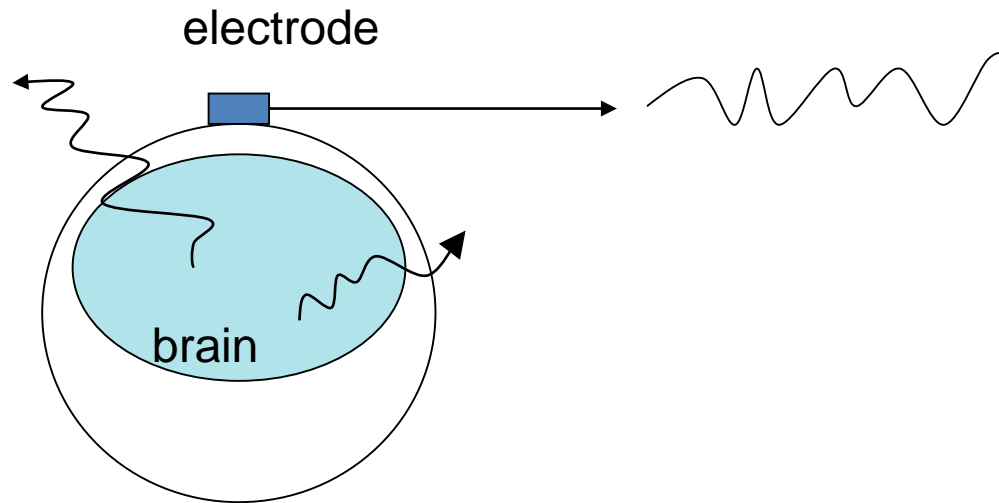
- Psychokinesis challenge
- Idea of EEG based psychokinesis
- Pioneering result, 1988
- Other results in 20th century
- Application of Brain-Computer Interface in 21st century
- EPSCoR support of the SCSU BCI group
- Current engagement of SCSU BCI group

Introduction: The challenge of psychokinesis

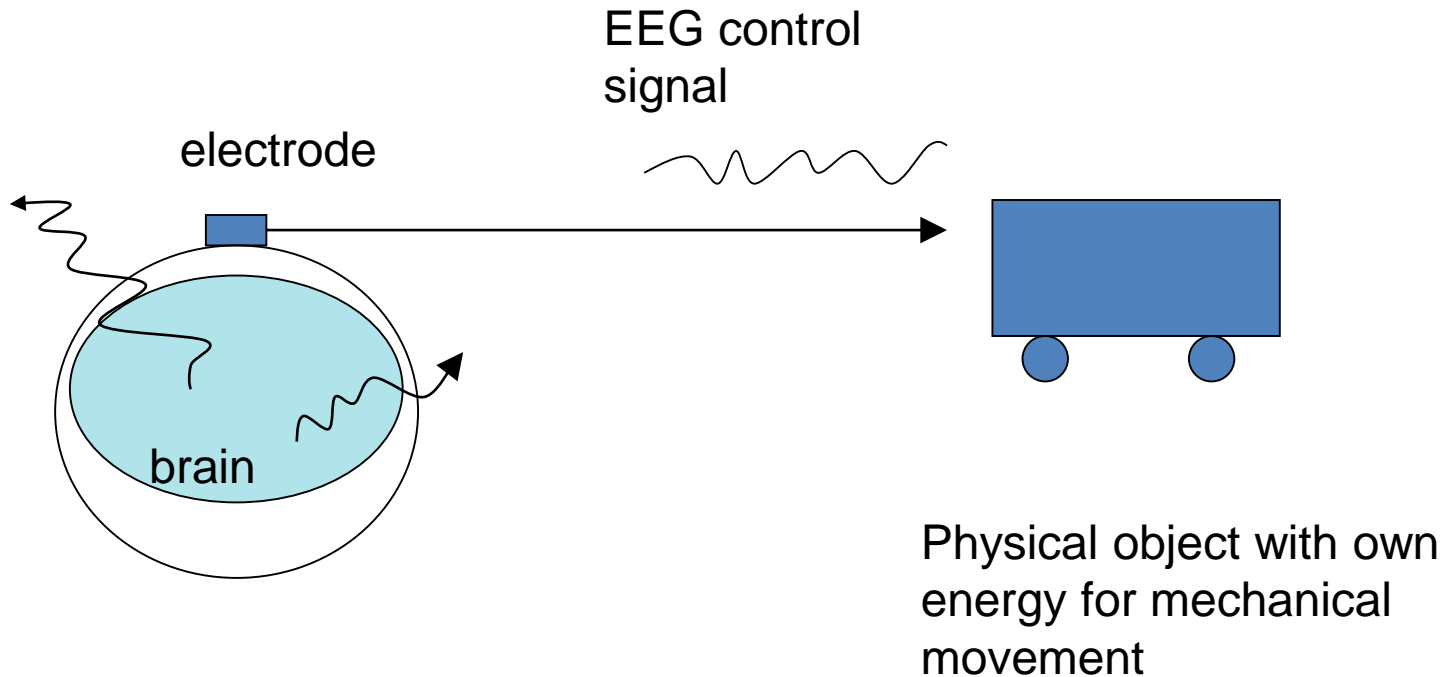
- It was an old dream of people to move physical objects using energy emanating from human brain. In science fiction literature it was named psychokinesis.

Idea: EEG-based psychokinesis

- Observation 1987: EEG is measured on the scalp and electromagnetic energy is generated by the brain: So EEG is representation of electromagnetic energy generated by the brain. Is EEG-based psychokinesis possible?



Conceptual design



Experimental proof of the concept, 1988

Brain-computer interface - Wikipedia - Internet Explorer

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Brain-computer interface

From Wikipedia, the free encyclopedia

A **brain-computer interface (BCI)**, sometimes called a **mind-machine interface (MMI)**, **direct neural interface (DNI)**, or **brain-machine interface (BMI)**, is a direct communication pathway between an enhanced or wired **brain** and an external device. BCIs are often directed at researching, mapping, assisting, augmenting, or repairing human cognitive or sensory-motor functions.

Research on BCIs began in the 1970s at the [University of California, Los Angeles \(UCLA\)](#) under a grant from the [National Science Foundation](#), followed by a contract from [DARPA](#).^{[1][2]} The papers published after this research also mark the first appearance of the expression *brain-computer interface* in scientific literature.

In 1980s a report was given on control of a physical object, a mobile robot, using EEG signals [S. Bozinovski, M. Sestakov, L. Bozinovska: Using EEG alpha rhythm to control a mobile robot, In G. Harris, C. Walker (eds.) Proc IEEE Annual Conference on Medical and Biological Society, New Orleans, p. 1515-1516, 1988][S. Bozinovski: Mobile robot trajectory control: From fixed rails to direct bioelectric control, In O. Kayniak (ed.) Proc. IEEE Workshop on Intelligent Motion Control, p. 63-67, 1990].

The field of BCI research and development has since focused primarily on neuroprosthetics applications that aim at restoring damaged hearing, sight and movement. Thanks to the remarkable [cortical plasticity](#) of the brain, signals from implanted prostheses can, after adaptation, be handled by the brain like natural sensor or effector channels.^[3] Following years of animal experimentation, the first [neuroprosthetic](#) devices implanted in humans appeared in the mid-1990s.

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- Versus neuroprosthetics
- Animal BCI research
 - Early work

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20th century achievements

- 1988, Pioneering achievement, in Macedonia, (Bozinovski, Sestakov, Bozinovska): Energy emanating from human brain, non invasively
- 1999, second control of a physical object, in North Carolina (Chapin, Moxon, Markowitz, Nicolelis): Energy measured inside brain of an animal, a rat, invasively
- In 20th century there was no other result in controlling physical objects using energy generated by the human brain

Brain-Computer Interface

- Brain computer interface is a way of controlling both virtual objects on computer screen and physical objects, using biosignals

Applications of Brain-Computer Interface

- In 21st century there are thousands of reports about using brain and other signals to control both virtual objects on the screen and physical objects

Application of brain computer interface

- Writing a text on a computer screen
- Moving a visual object on a computer screen
- Moving a physical object
 - A robot
 - A wheelchair
 - A prosthesis

EPSCoR support for the SCSU brain-computer interface group

- 2005-2009 RII for Neuroscience and Brain Computer Interface at SCSU
- 2009-2011 RII for masters program in Biorobotics and Biofabrication at SCSU

Current work on BCI at SCSU

- Building low cost devices for Brain-Computer Interface
- Report:. Mental states, EEG manifestations, and mentally emulated digital circuits for brain-robot interaction, IEEE Transactions on Autonomous Mental Development, 7(1) 2015