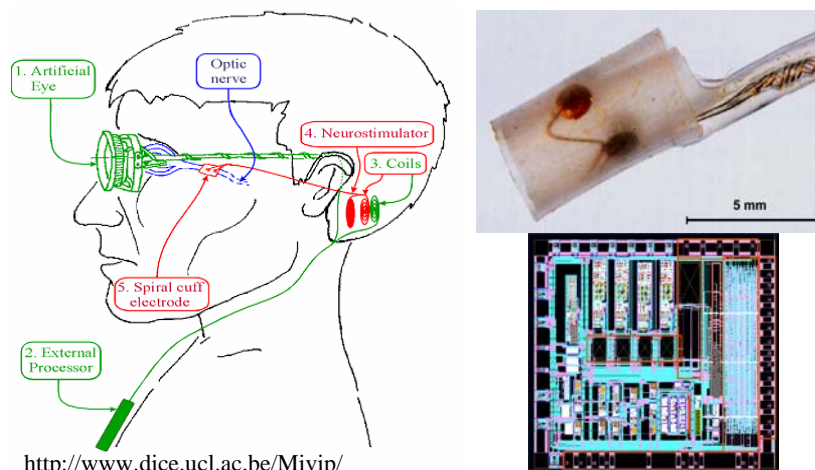


visual prosthesis
video



Courtesy of Dr. Claude Veraart, Université catholique de Louvain, 2004

Functional prototype of visual prosthesis
interfaced
with the optic nerve.

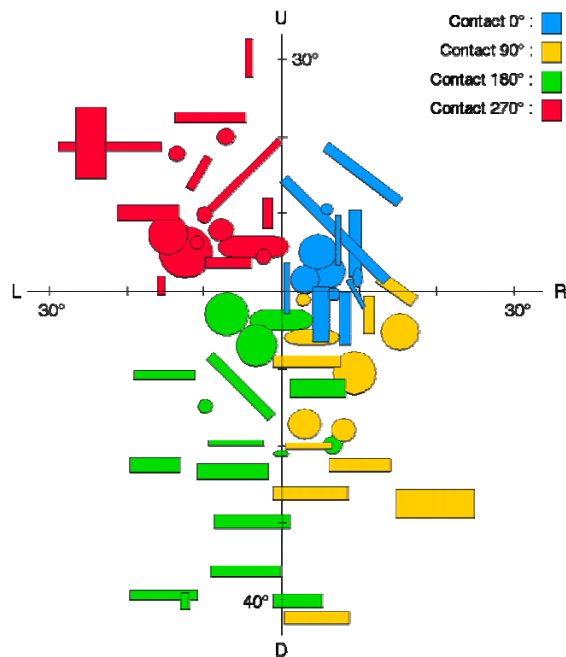


<http://www.dice.ucl.ac.be/Mivip/>

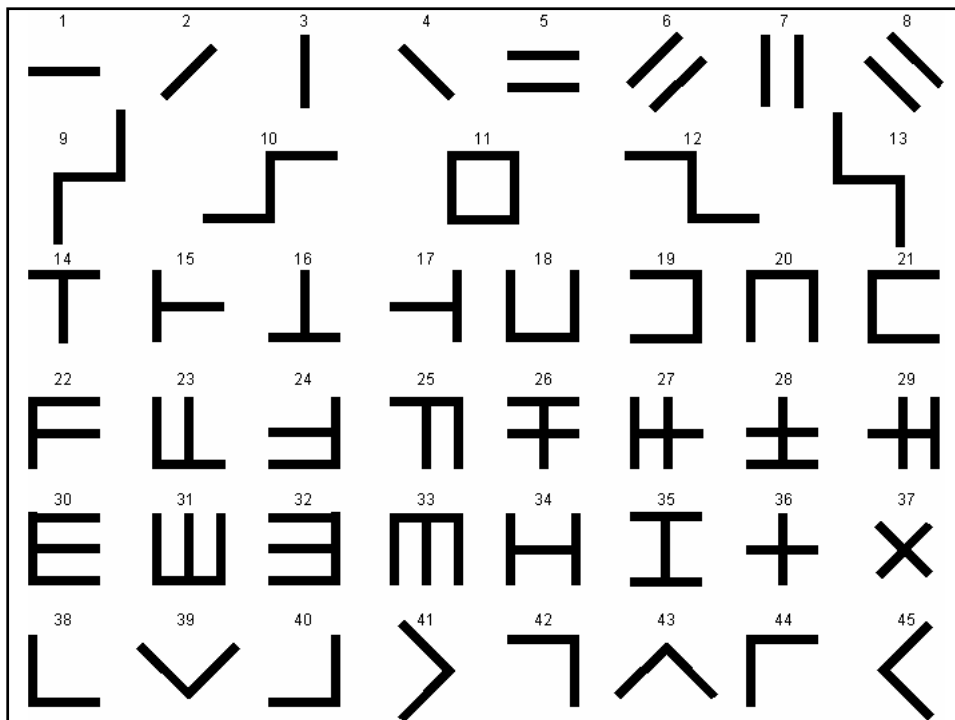
Claude Veart, Université Catholique de Louvain, Belgium

Optic nerve selective stimulation

Phosphene position depends on the cathodic contact selected to deliver the stimulation



Veraart et al, Brain Research, 1998,813:181-186)



뇌심부 자극기(Deep Brain Stimulator)

Neurological Movement Disorder

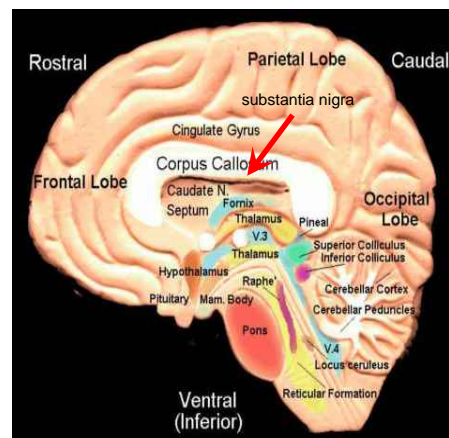
발병 원인

운동기능을 담당하는 뇌심부 구조물(substantia nigra) 에 존재하는 억제성 신경세포(inhibitory neuron)의 소실로 인하여 연결한 신경망의 over-activities 발생

→ Movement Disorders 야기

종류 및 증상

- Parkinson's Disease
 - Tremore at rest state
 - lower shaking frequency
 - Ceases during purposeful movement
- Essential Tremor (본태성 진전)
 - Tremore during movement
 - Higher shaking frequency
- Dyskinesia (이상운동증)
 - Power Impairment of voluntary movement
- Dystonia (근긴장이상증)
 - Disordered tonicity of muscles



Treatments for Movement Disorders

Ablative Surgery

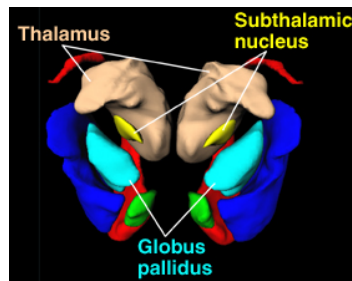
- Over activities를 보이는 심뇌부위를 제거함으로써 운동장애를 호전시키는 방법으로 20세기 초반부터 연구되어 온 가장 고전적인 방법
- 현재까지도 사용되고 있는 치료법이나, 절제 시 부작용에 의해 주변 뇌의 기능의 손상을 야기할 수 있음.

Drug Medication

- 신경전달물질을 이용한 약물을 투여하여 운동장애를 호전시키는 방법
- 증세가 호전되는 비율이 낮고, 시간의 경과에 따라 효과가 떨어짐.

Deep Brain Stimulation

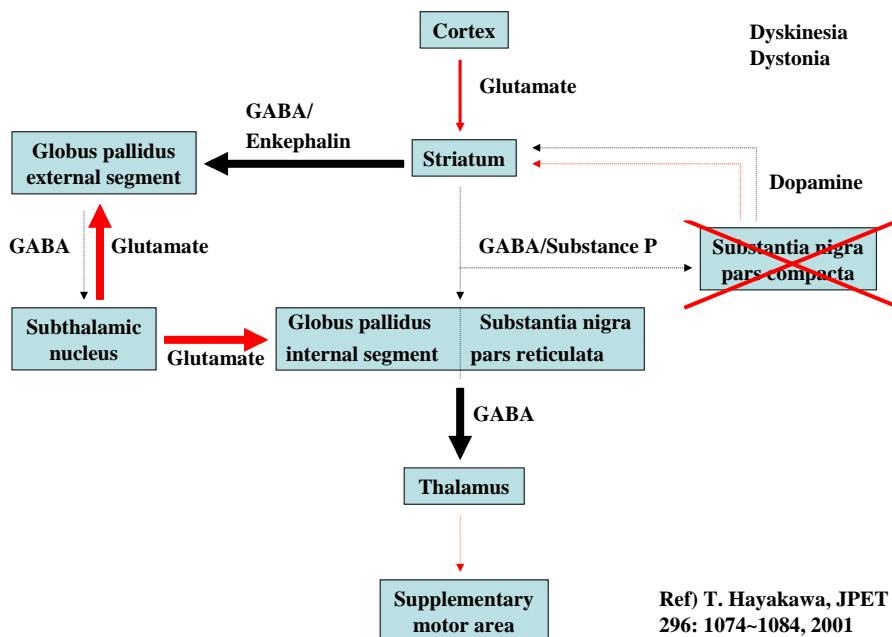
- 병변 부위에 전극을 삽입하여 전류자극을 줌으로서 운동장애를 극적으로 호전시키는 방법
- Tremor를 포함한 각종 운동장애에 효과가 있는 것으로 밝혀져 활발히 연구가 진행 중에 있음.



Three Stimulating Targets of DBS

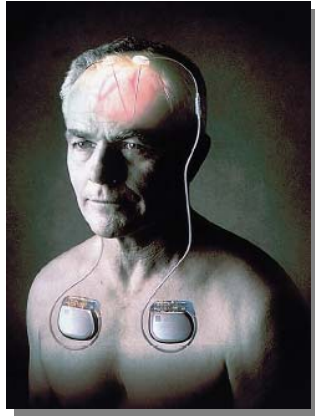
- Thalamic nucleus (시상핵)
- Subthalamic nucleus (시상하핵)
- Globus pallidus (창백핵)

PD pathway



Ref) T. Hayakawa, JPET 296: 1074-1084, 2001

DBS; Deep Brain Stimulation



DBS system 구성

Implantable Components

- Self-powered neurostimulator
- Electrode
- Connection leads



Patient Component

Use magnet link to turn neurostimulator off or on



Physician Programmer

Programmer, printer, and programming head. Communicate via telemetry to adjust neurostimulator parameters.

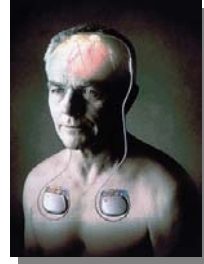
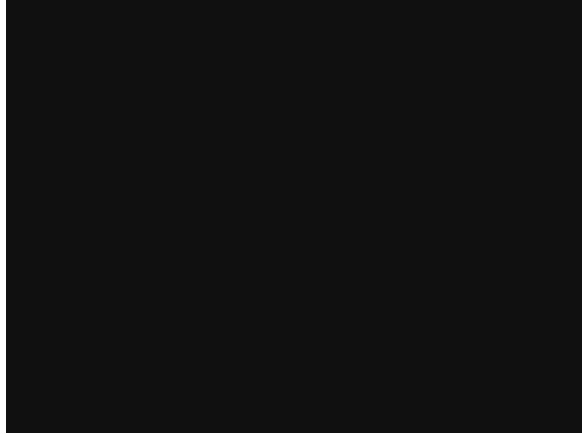


Neurological Test Stimulator

Device tests the effectiveness of stimulation intraoperatively or during a test stimulation period.



DBS Video



Medtronic Inc. Aactiva® Tremor Control Therapy

BCI (Brain Computer Interface)

In the futuristic vision of the Wachowski brothers' movie trilogy "The Matrix," humans dive into a virtual world by connecting their brains directly to a computer.....



Movie fiction: The Matrix, Bionic Woman, Spider Man, i Robot...etc.

한림대 이현주자료

Motivation for BCI/BMI Research

In USA, more than 200,000 patients live with the motor sequelae (consequences) of serious injury. There are two ways to help them restore some motor function:

- Repair the damaged nerve axons
- **Build neuroprosthetic device**

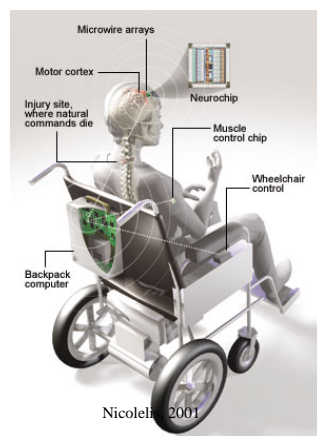


BrainGate by Cyberkinetics



Frank Sandoval

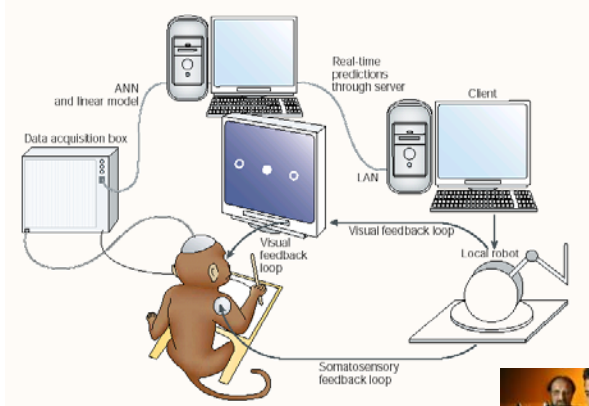
Brain-Computer Interface (BCI)



Sometimes called a **direct neural interface** or a **brain-machine interface**, is a direct communication pathway between a **brain** (or **brain cell culture**) and an external device.

한림대 이현주자료

BCI with Neurons in Motor Brain Area



Duke University Medical Center neurobiologist Miguel Nicolelis with an owl monkey and a robot arm which monkeys learned to operate using only their brain signals



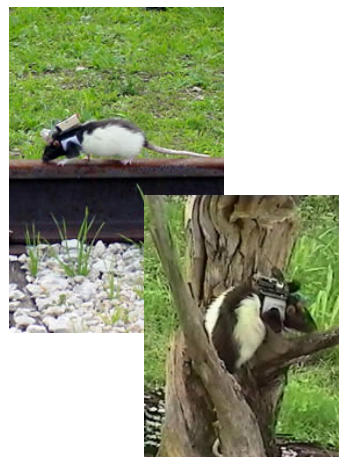
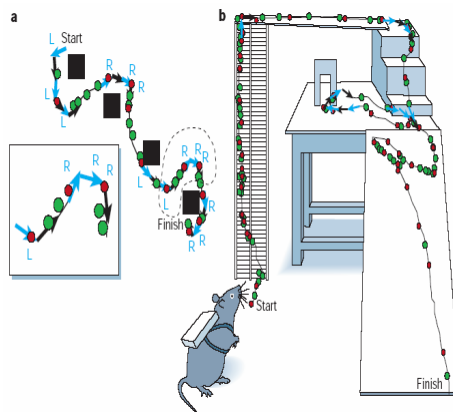
Learning to control a brain-machine interface for reaching and grasping by primates. Nicolelis et al., PLoS Biology 2003

한림대 이현주¹⁵자료



'Ratbot'

BCI with Pleasure Center stimulating for control



Rat navigation guided by remote control

Chapin et al., Nature, 2002

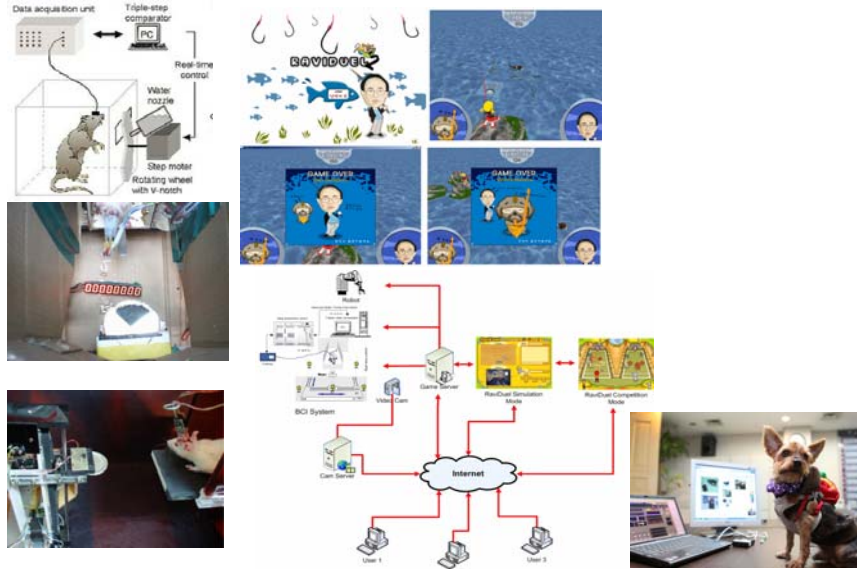


한림대 이현주¹⁵자료



'Super Animals'

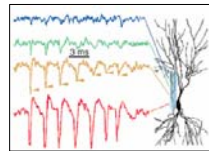
Encoding based Brain Machine Interface – Hallym Univ.



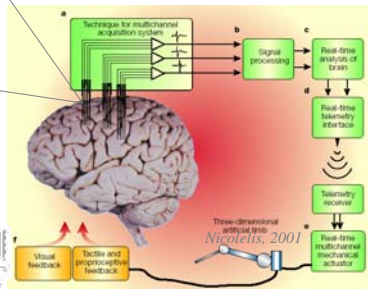
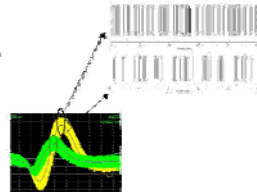
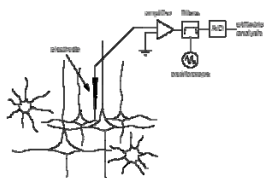
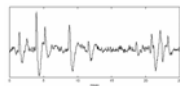
한림대 이현주자료

Neuron Spike based BCI

- high speed real time control
- invasive
- risk for clinical application



Spike sorting

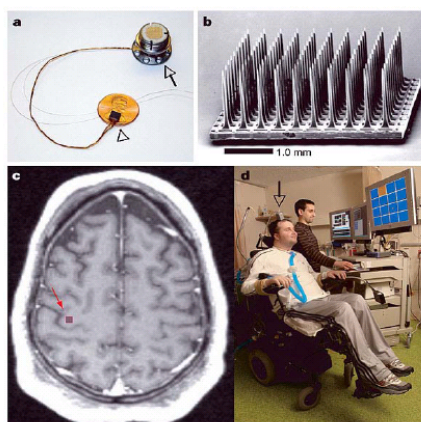


한림대 이현주자료

Non-invasive
Vs.
Invasive

한림대 이현주자료

BrainGate and placement, and the participant



Donohue Lab,
Brown Univ.