Case Study V: Simulation of brain potentials from transcranial stimulation

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Pipeline

Image Acq. & Processing

Seg3D

Segmentation & Structure Identification

Discrete points e.g., sensors

Shapeworks

Cleaver

Geometric Modeling & Fitting Structures

Meshing Volume Modeling

Boundary conditions

SCIRun

Measured Data

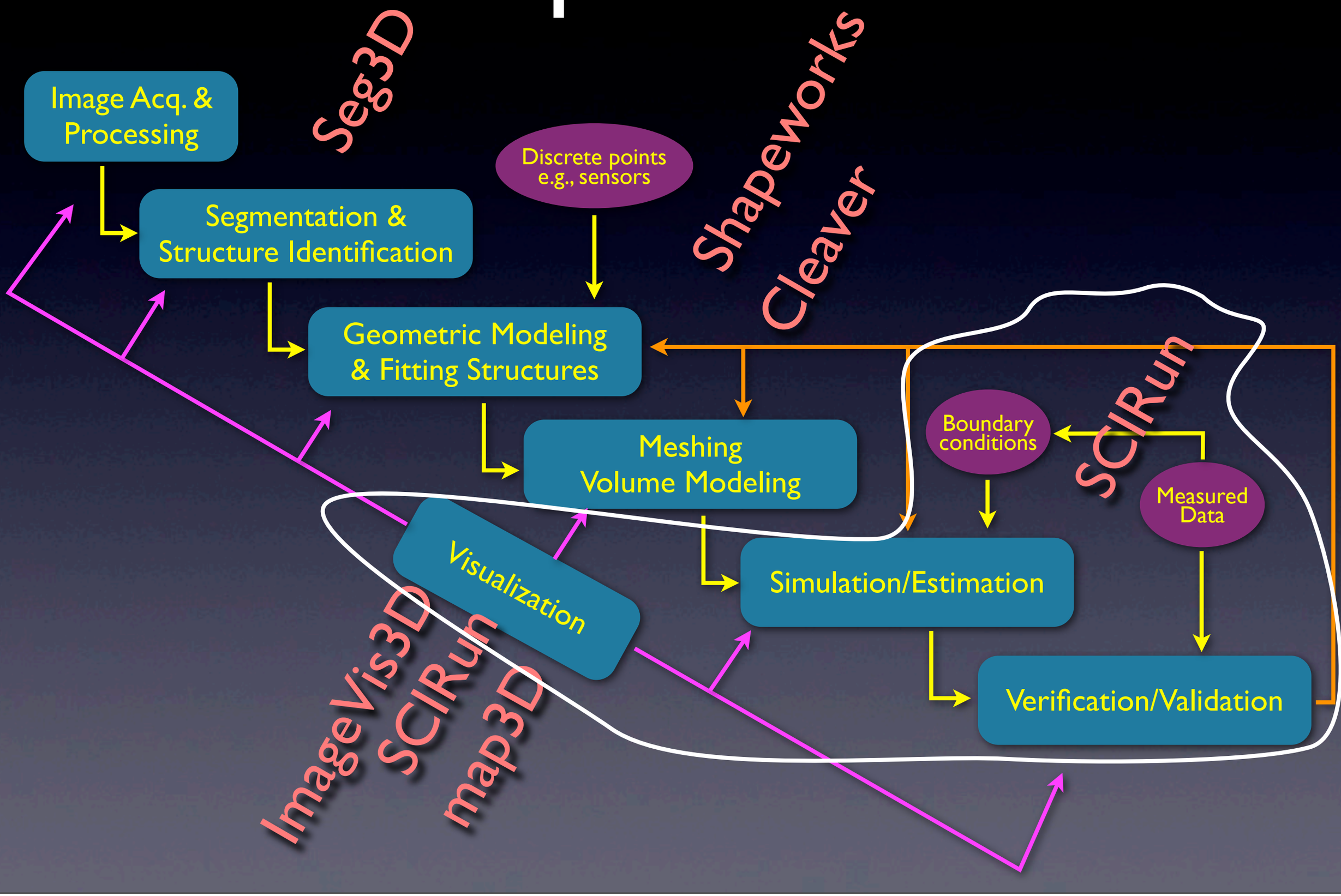
Simulation/Estimation

Verification/Validation

Visualization

ImageVis3D SCIRun map3D

Pipeline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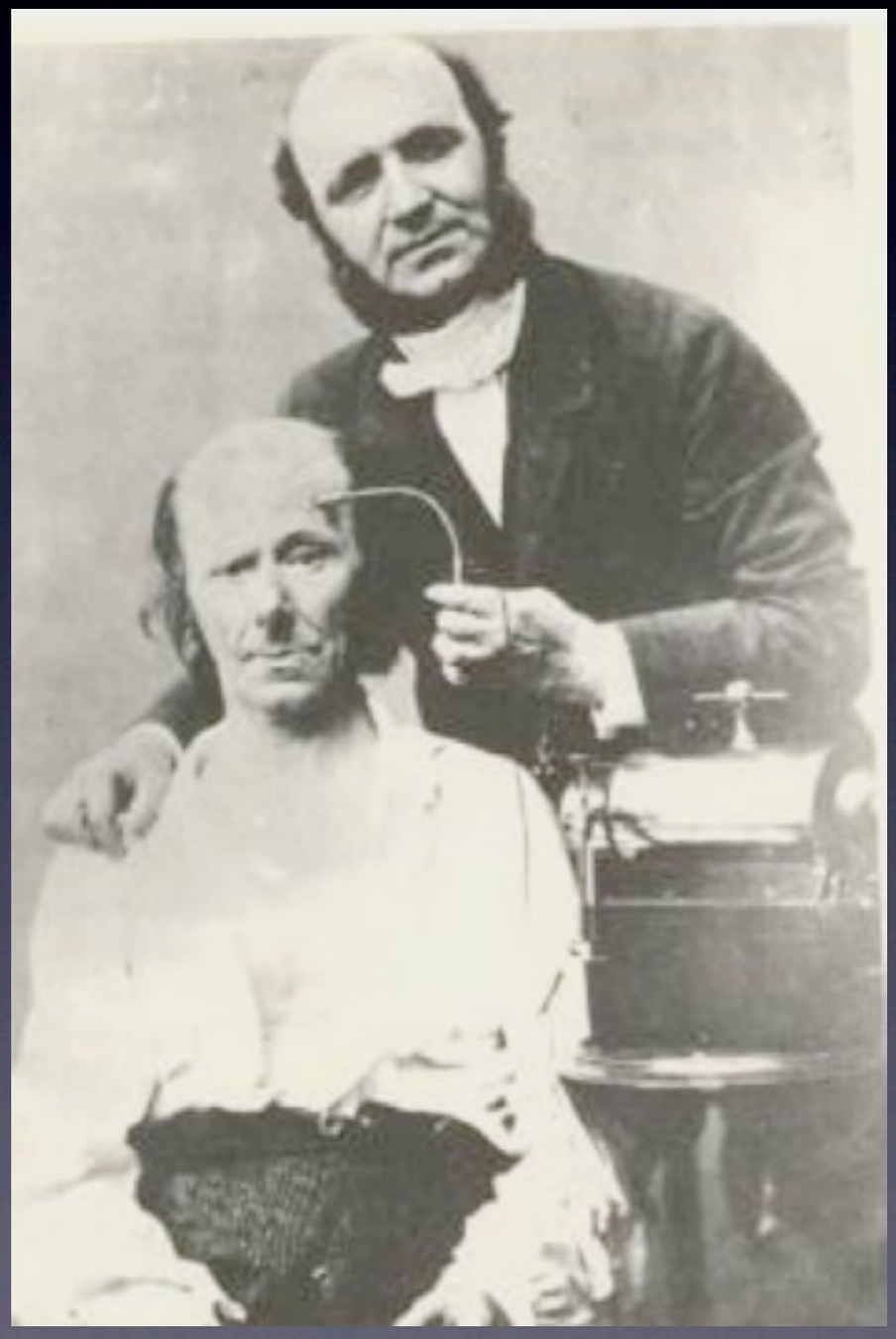
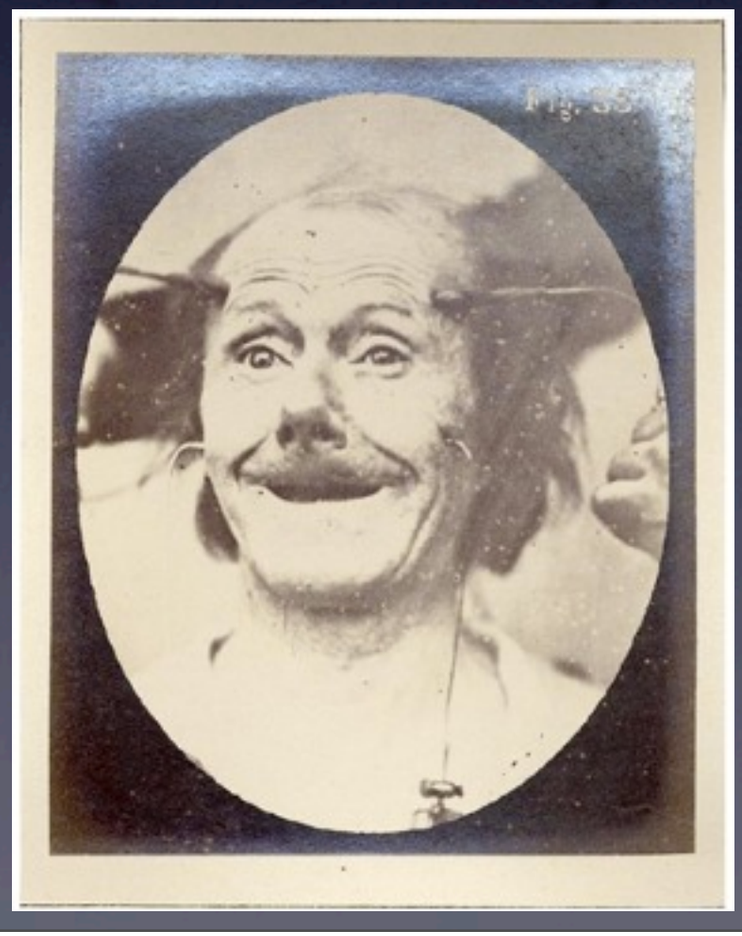
map3D

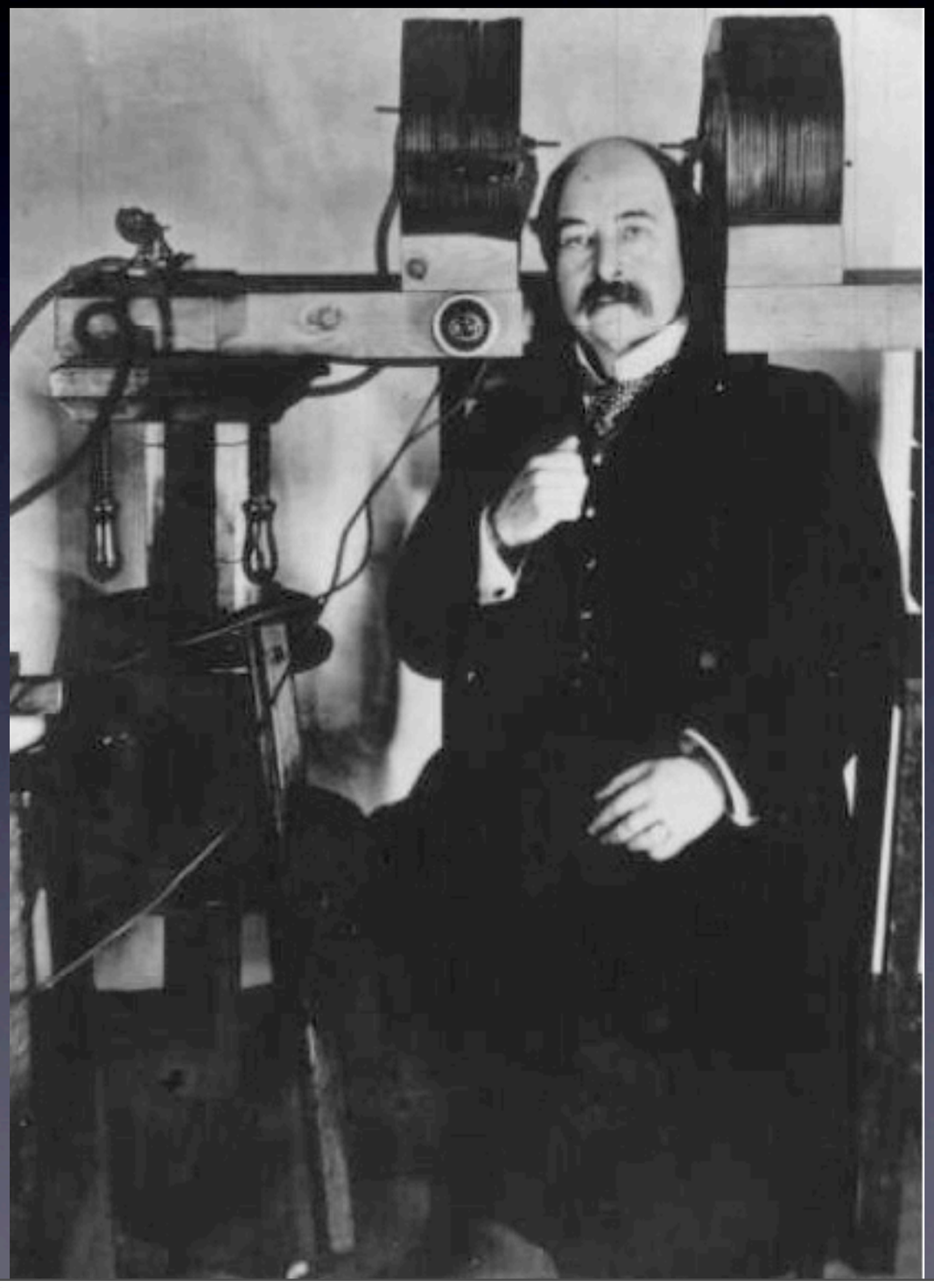
“Faradization”



Duchenne de Boulogne (1806-1875)

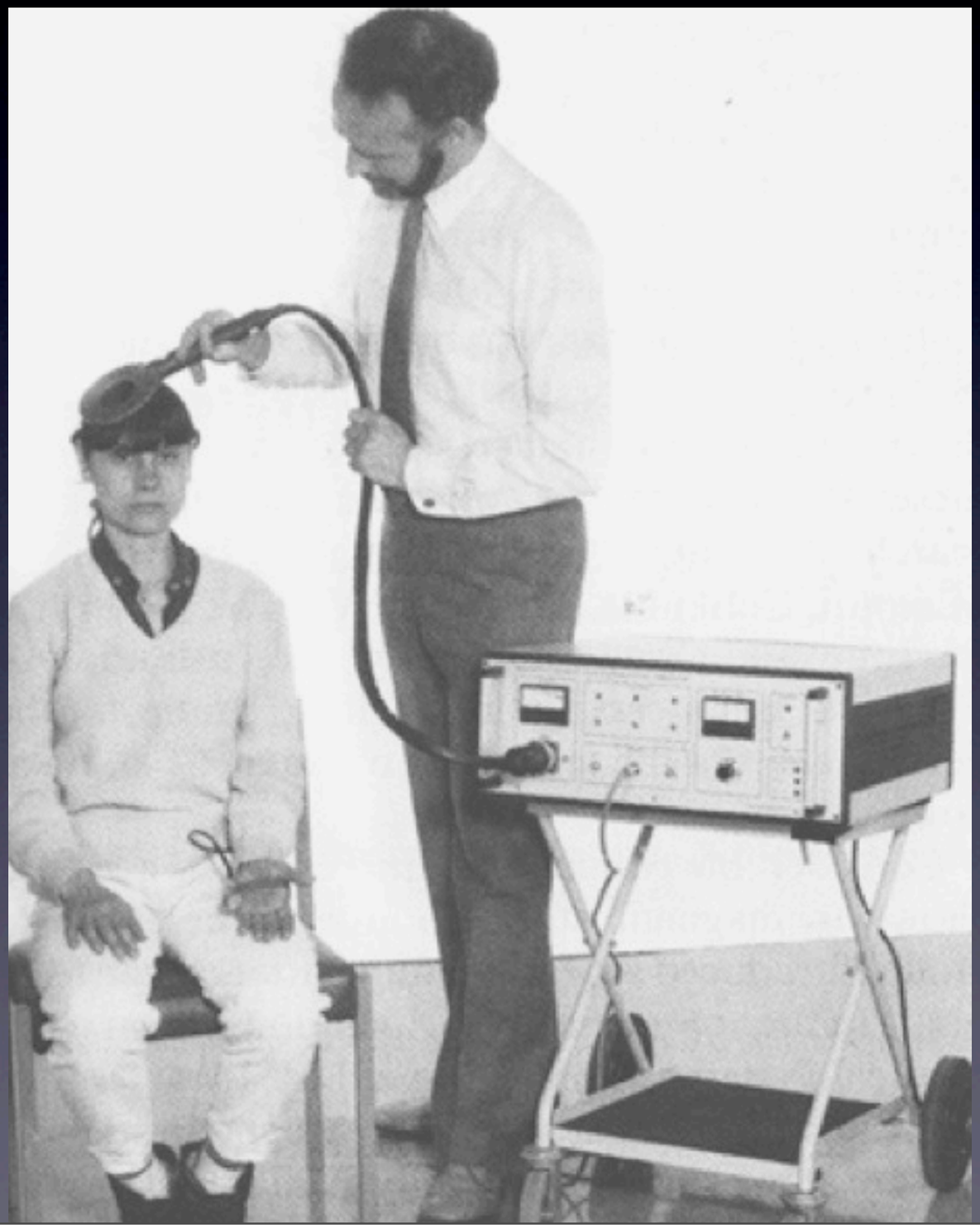


Transcranial Stimulation: Beginnings



Sylvanus P. Thompson, 1910

Transcranial Stimulation: Modern Era

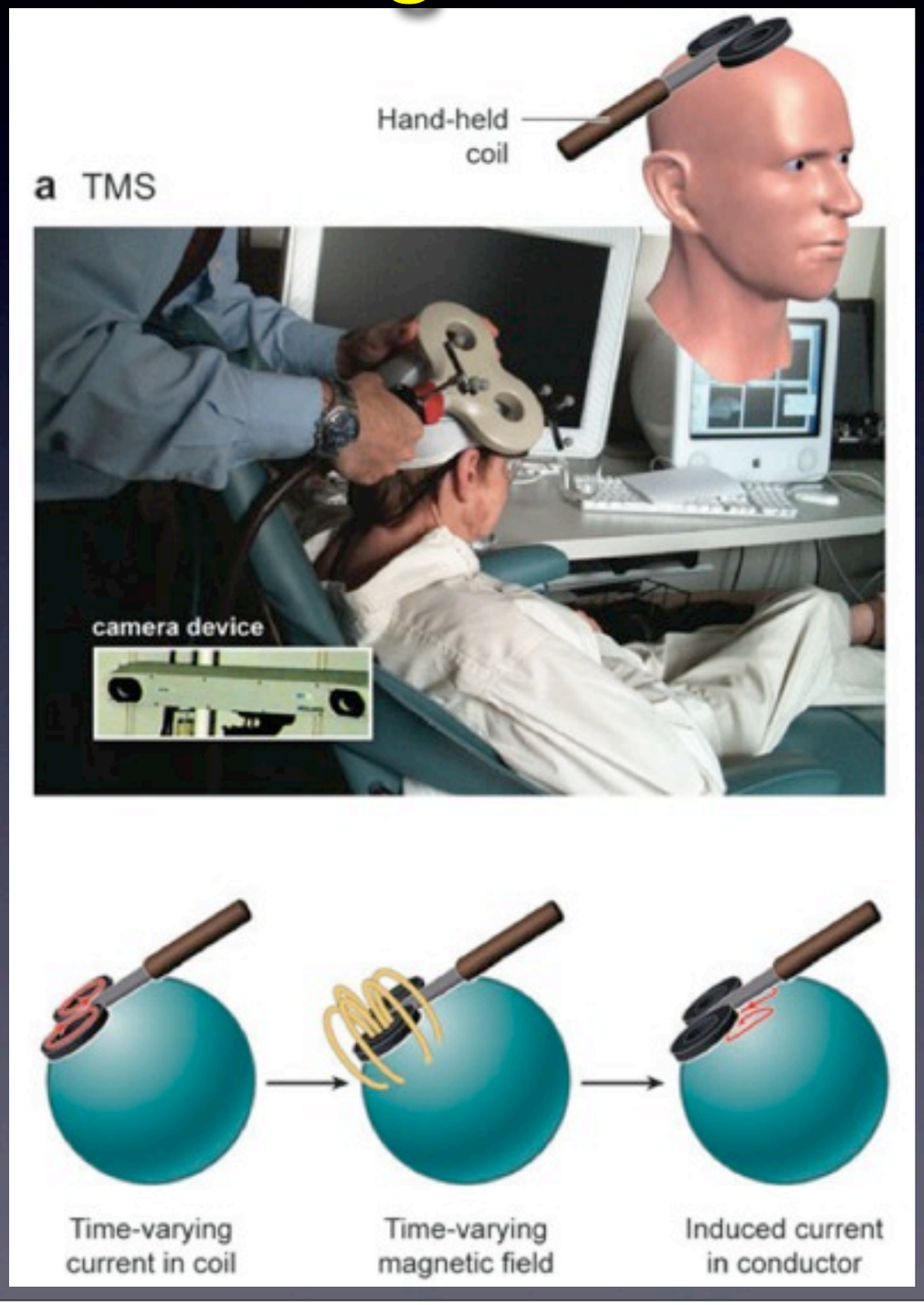


Anthony Barker, 1985

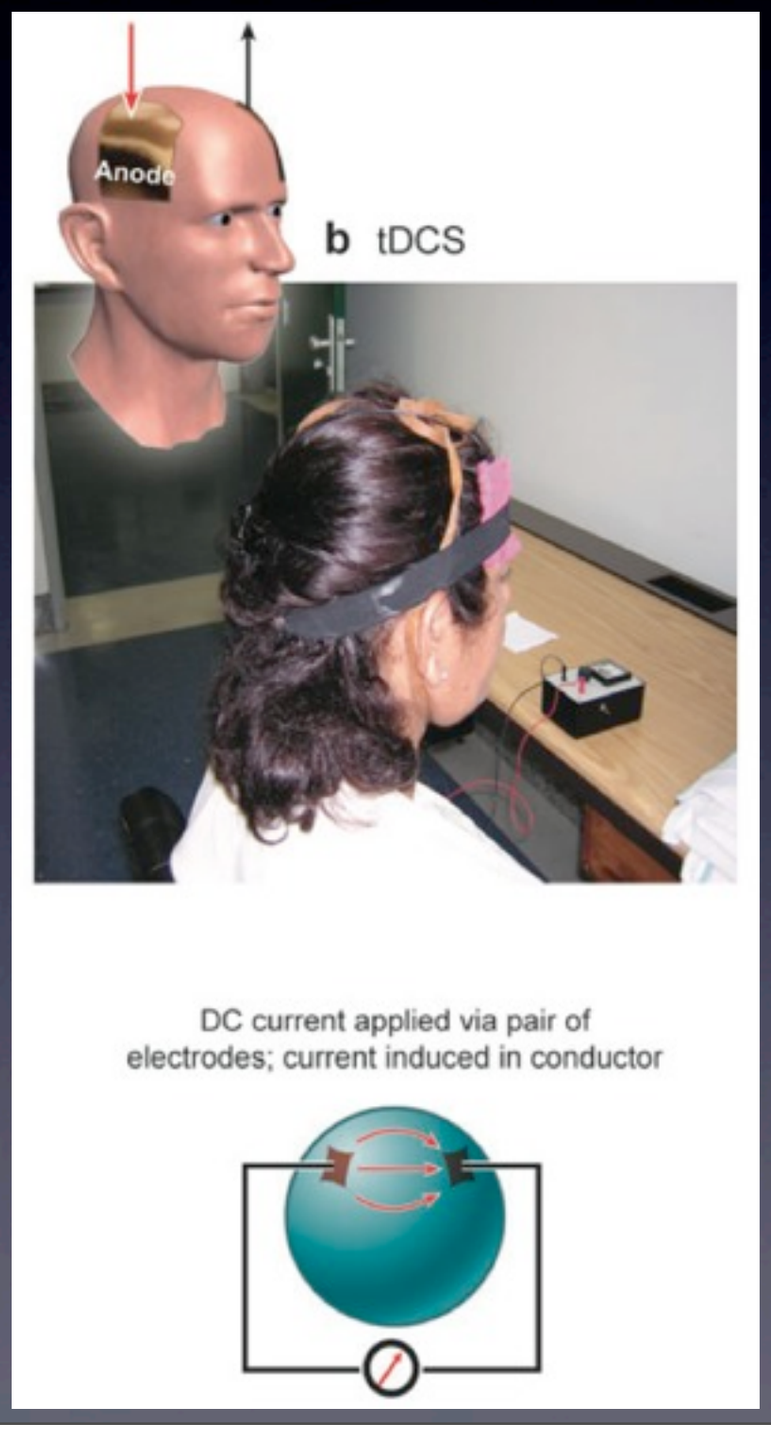
Stimulation Approaches

Stimulation Approaches

Magnetic



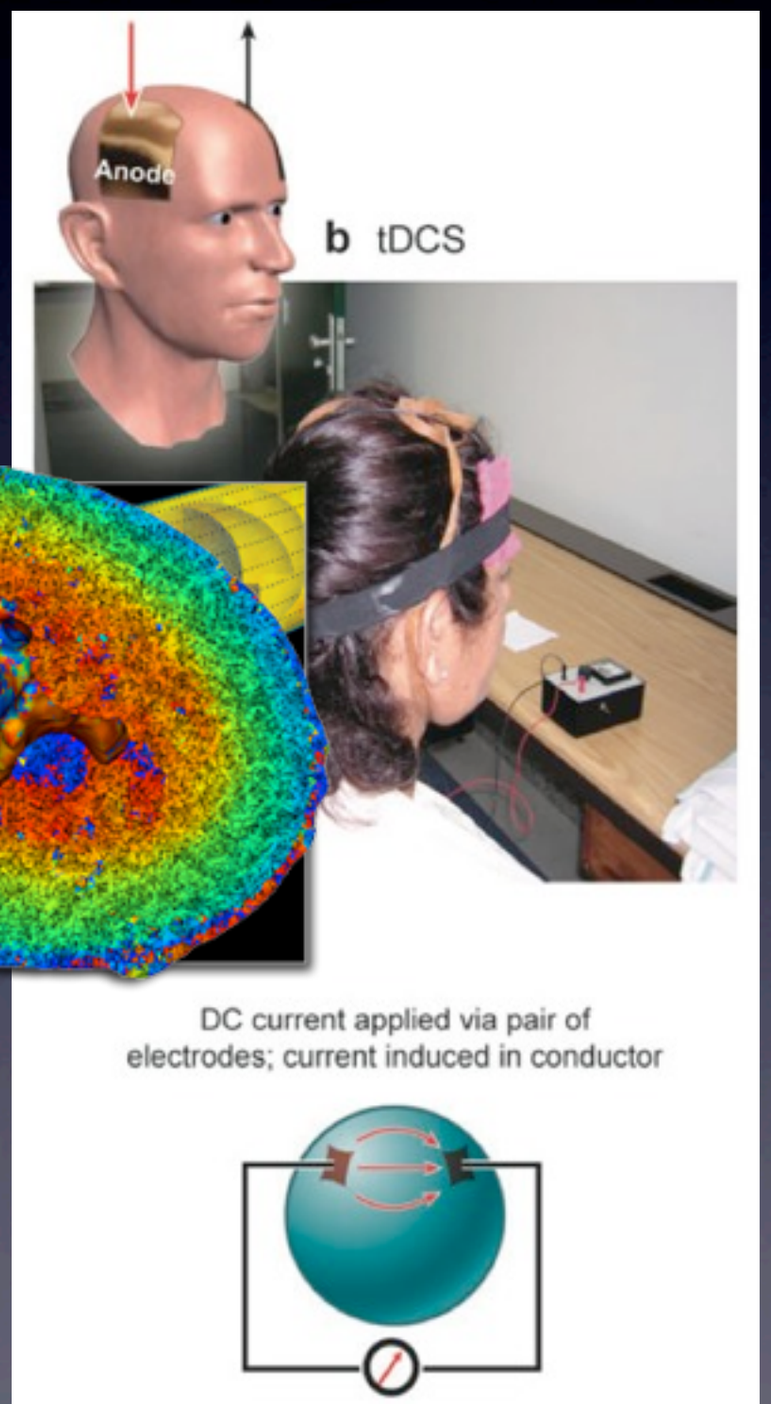
Electric



Stimulation Approaches

Magnetic

Electric



Medical Motivation

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Epilepsy

Traumatic Brain Injury

Neurological diseases

Eye-sight rehabilitation

Mood disorders

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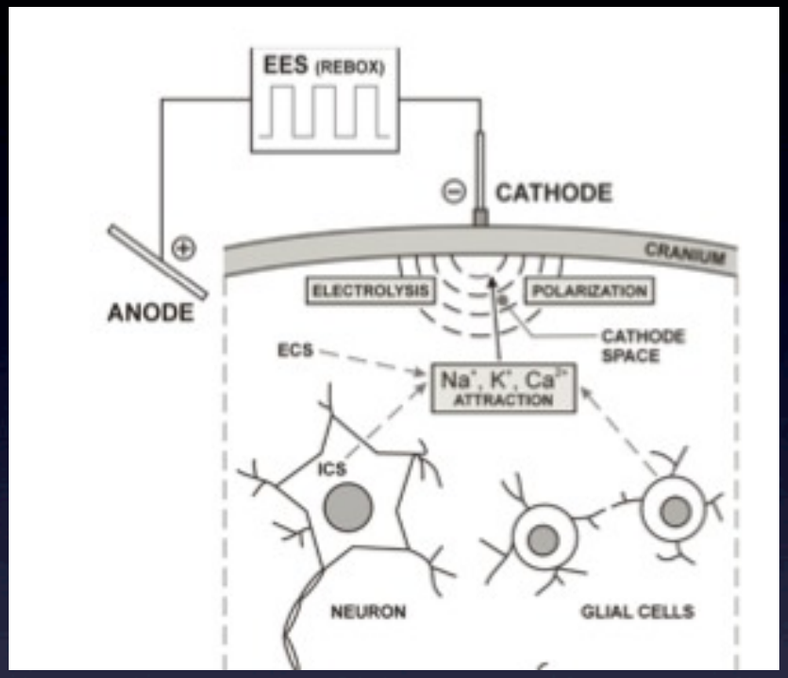
Mood disorders

tDCS Goals

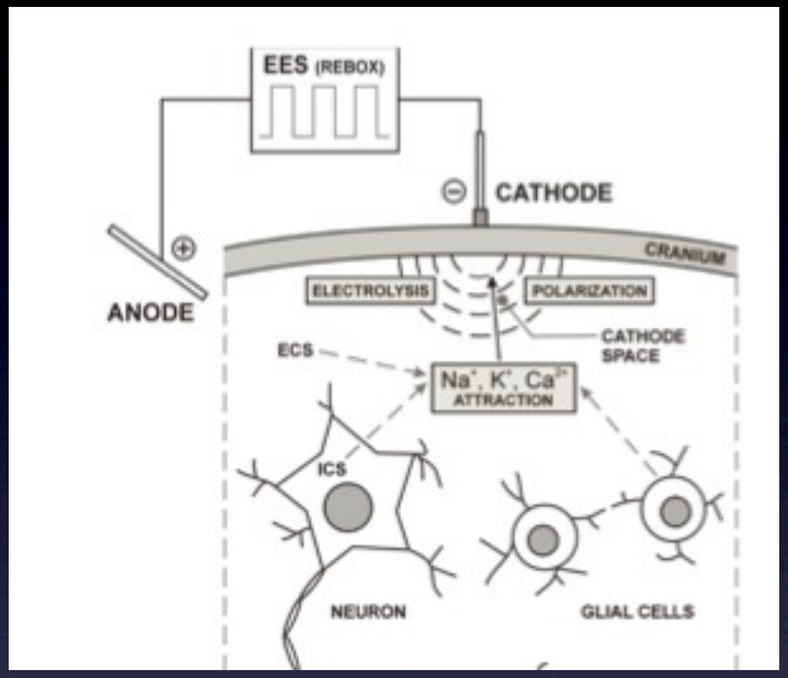
Clinical Goal



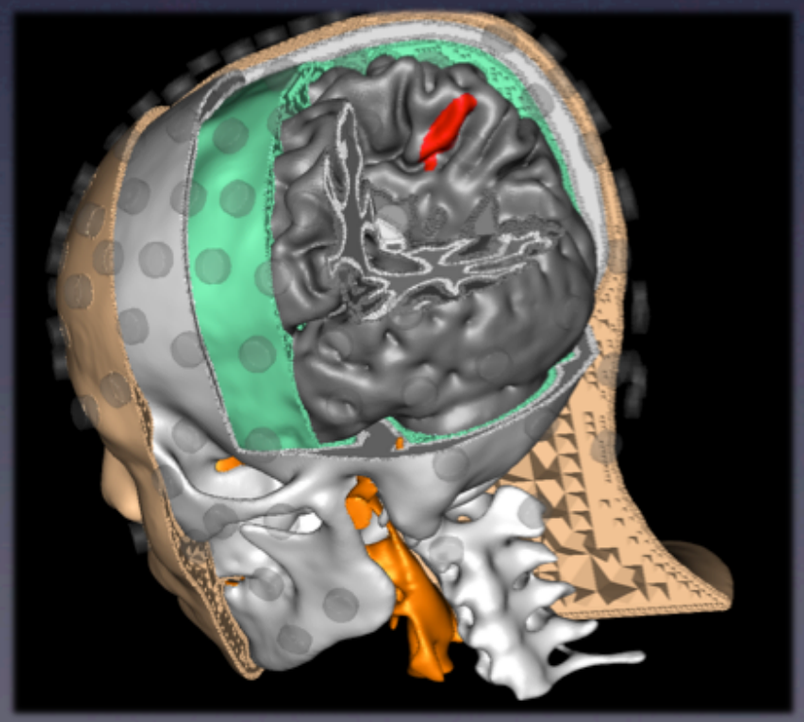
Technical Goal

tDCS Goals

Clinical Goal

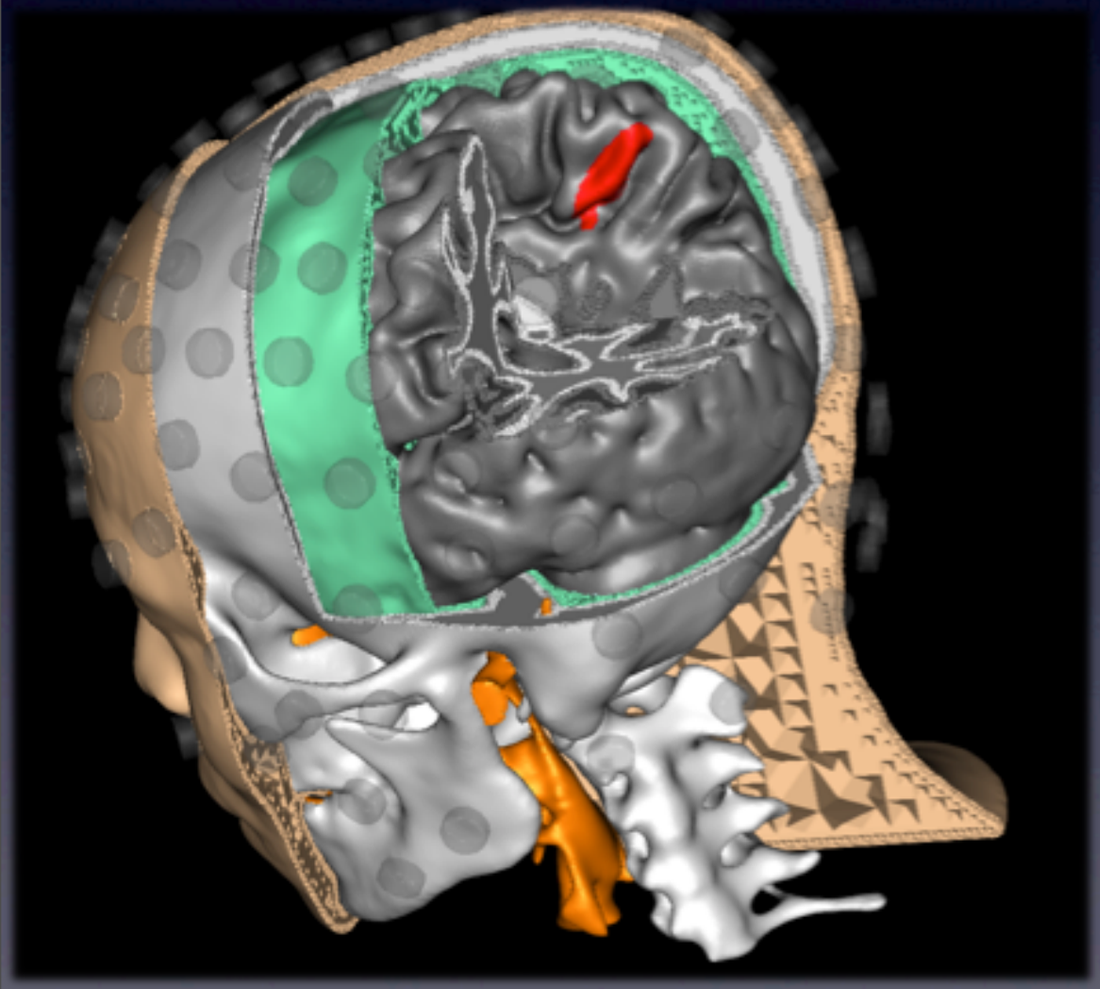


Technical Goal

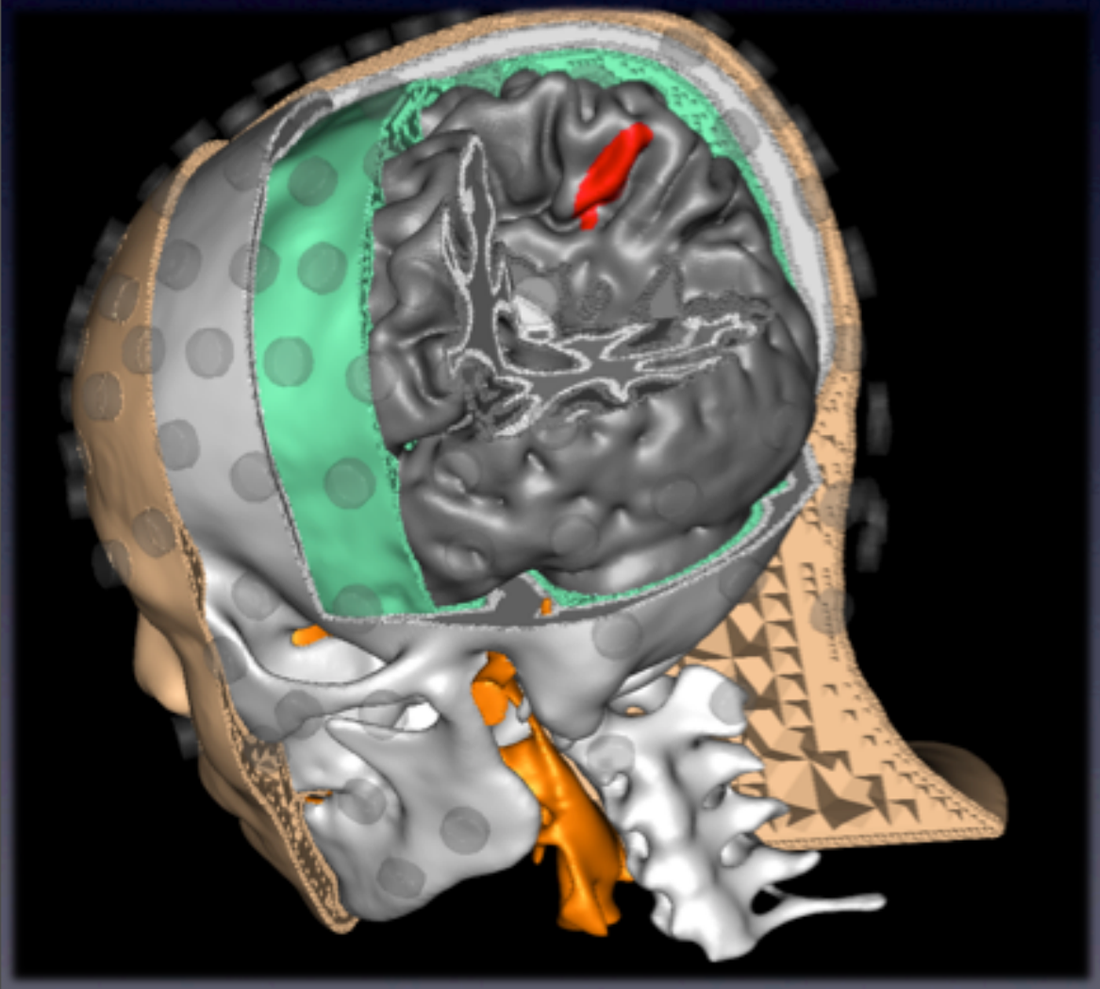


Modeling

Modeling

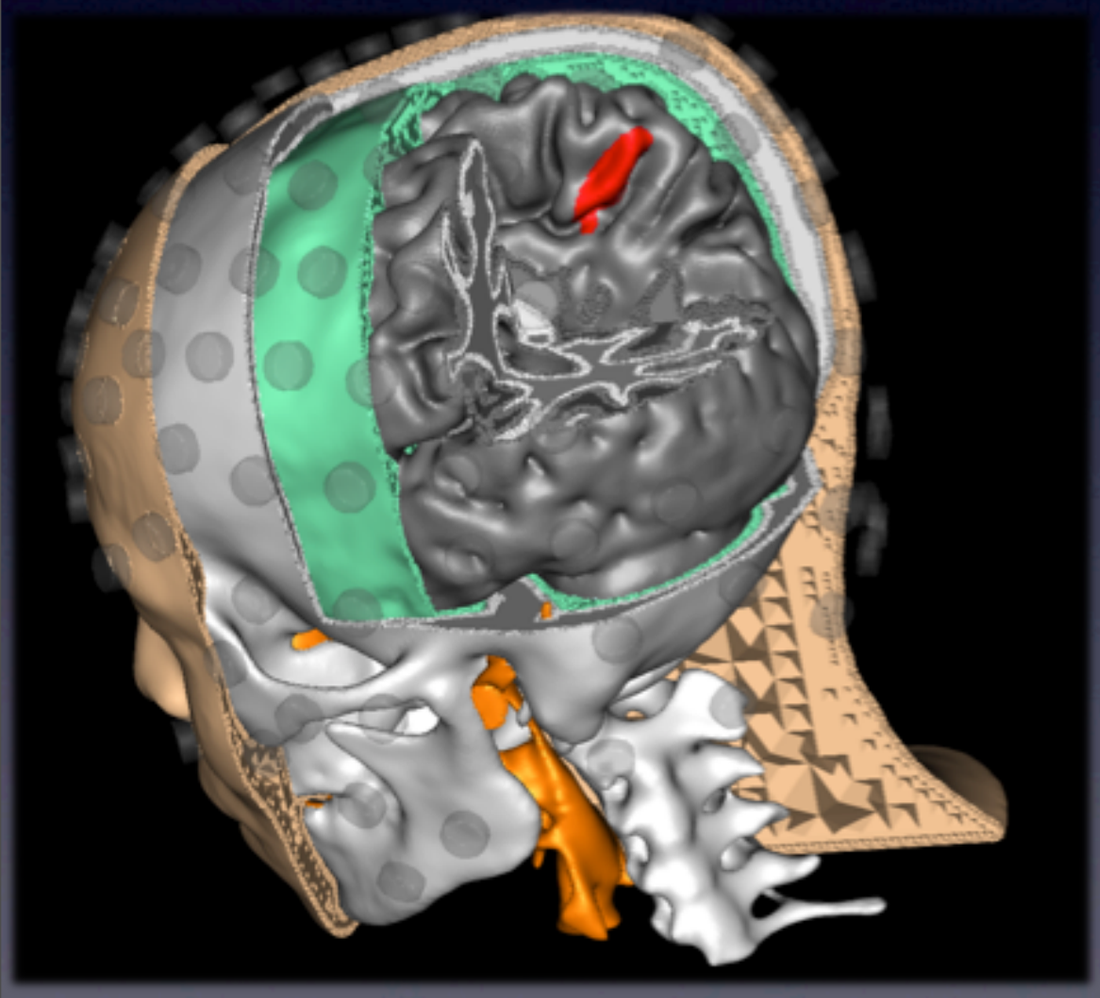


Modeling



Modeling

MRI CT DTI

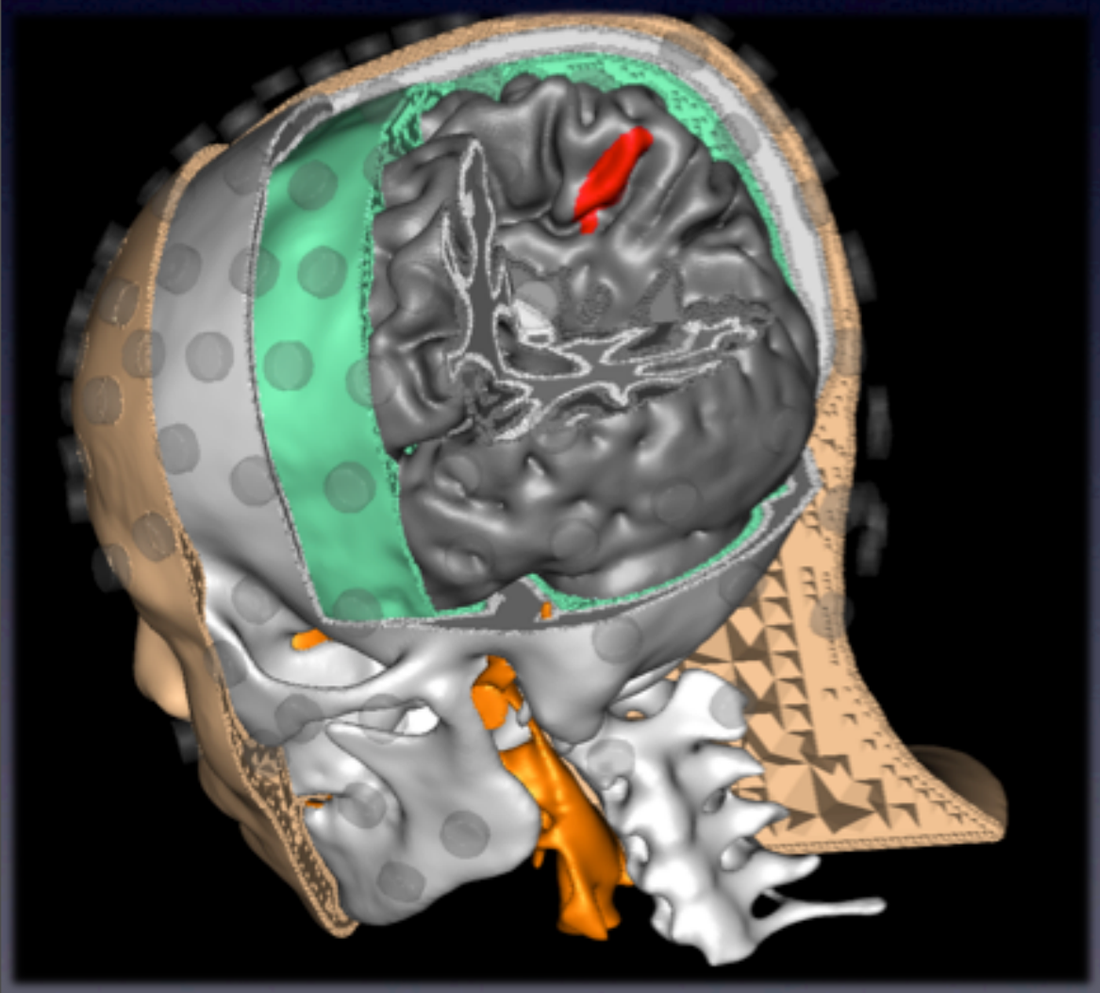


Modeling

MRI

CT

DTI



CIBCSeg3D

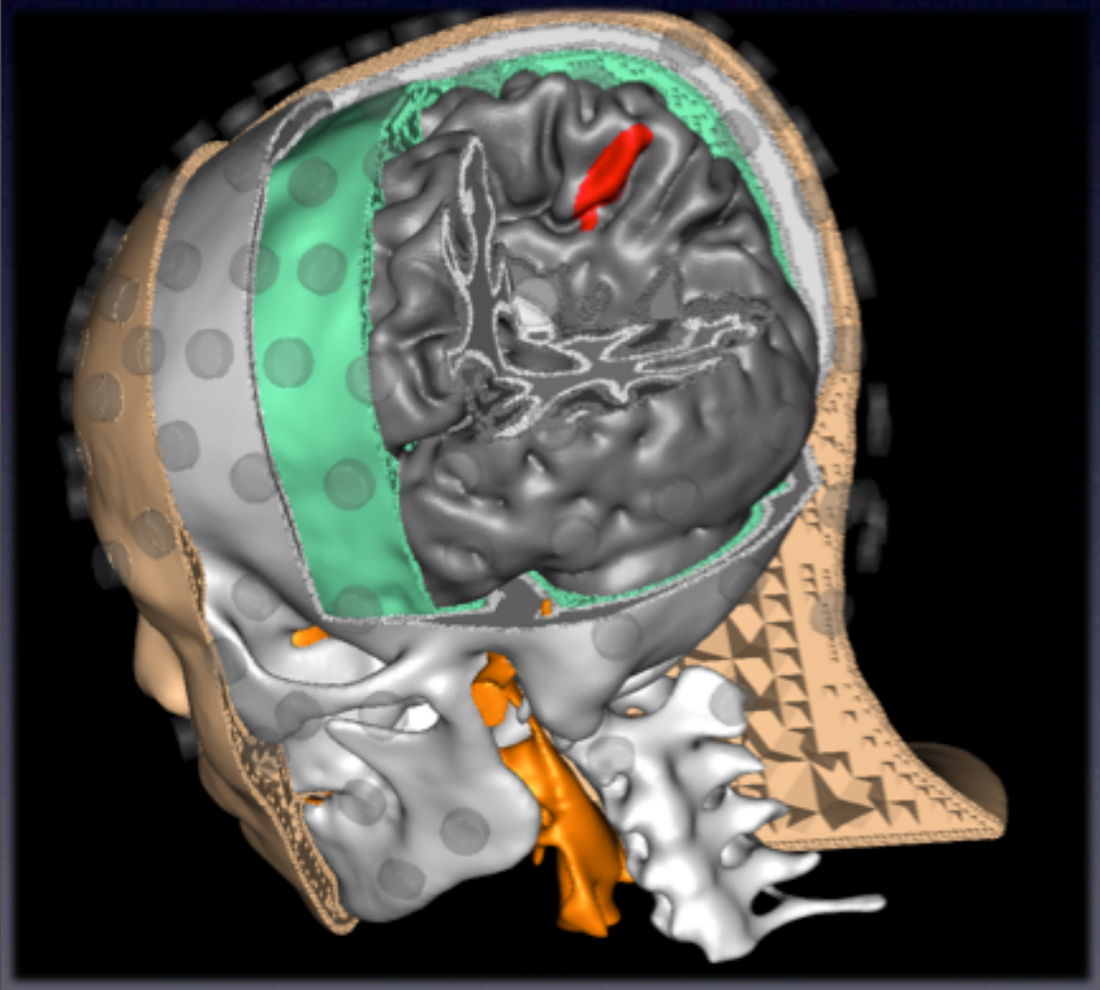
Multimodal integration

Modeling

MRI

CT

DTI



CIBCSeg3D

Segmentation

Multimodal integration

CIBCCleaver

Meshing

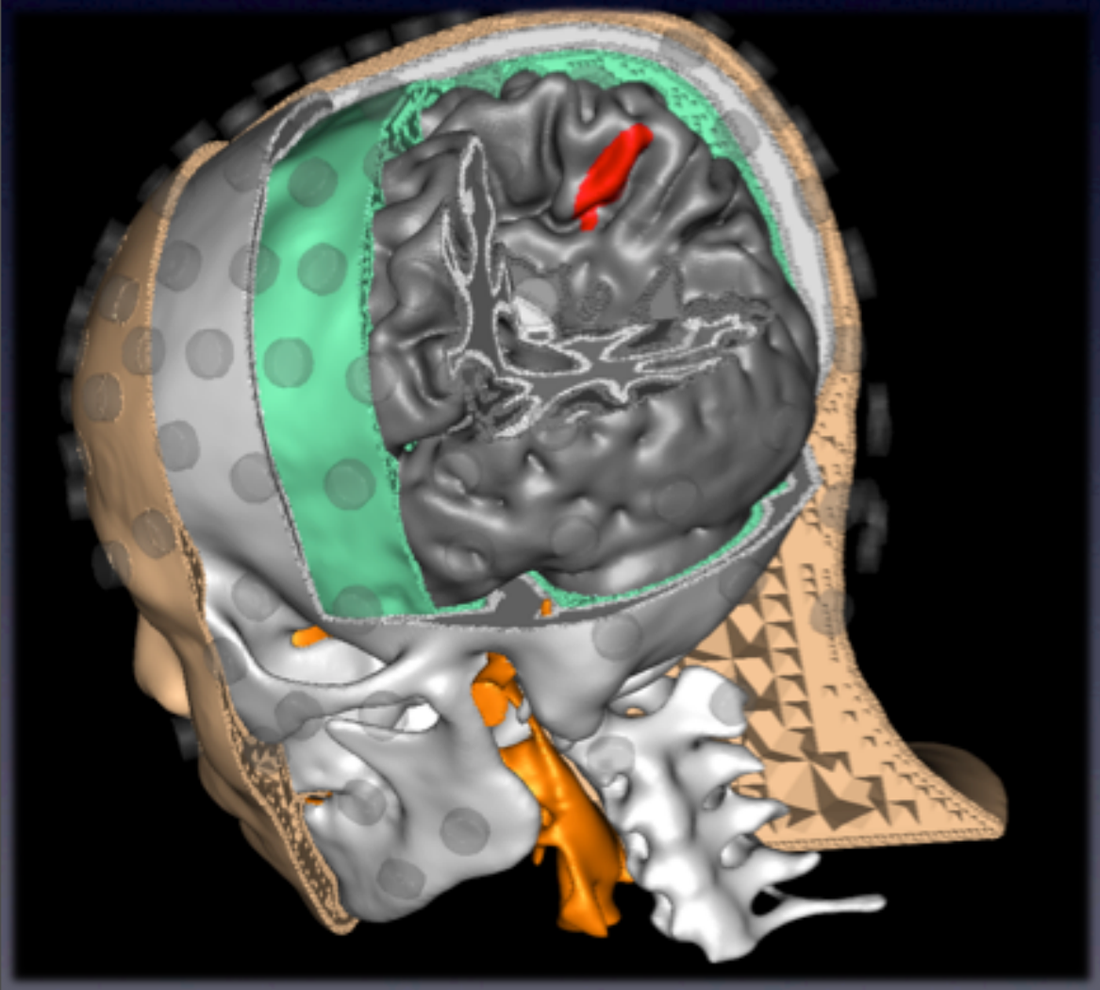
Tetrahedral mesh

Modeling

MRI

CT

DTI



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CIBCSCIRun

Simulation

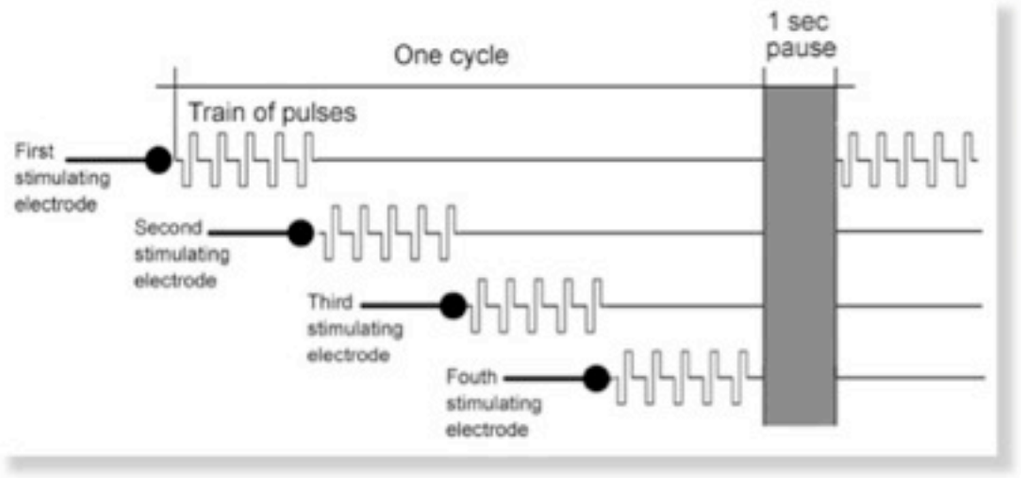
tDCS Simulation

Eye-sight rehabilitation

Treatment:

Non-invasive repetitive transorbital ACS (rtACS)

(10 days, approx. 20- 40 min daily, treatment of *intact* and *damage* eye)



<u>Stimulation parameters:</u>

→ Determine current thresholds for phosphene perception

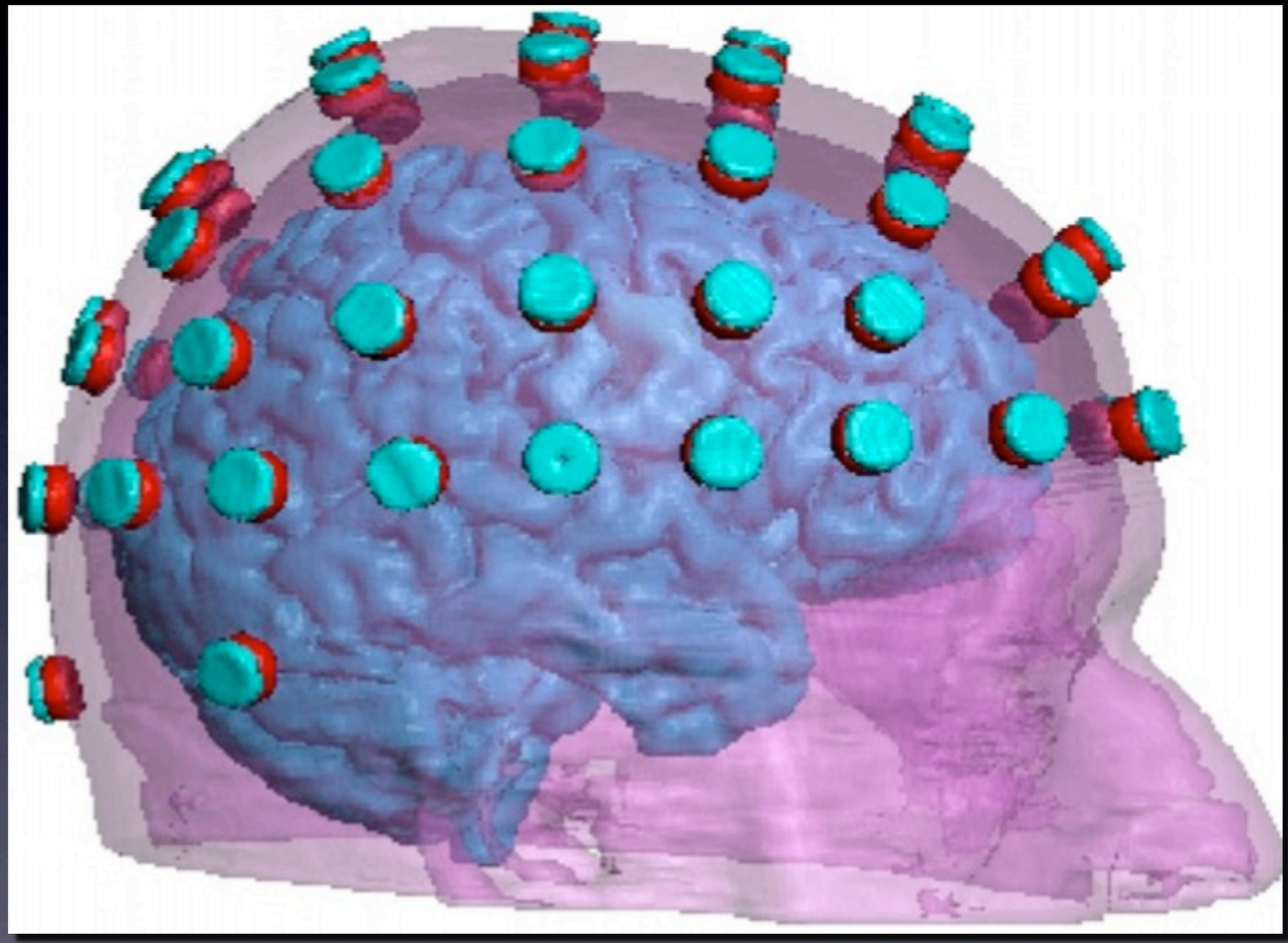
→ Obtain phosphene threshold (max. current intensity =1000μA)

→ Frequencies in α-range

Eye-sight rehabilitation

Eye-sight rehabilitation

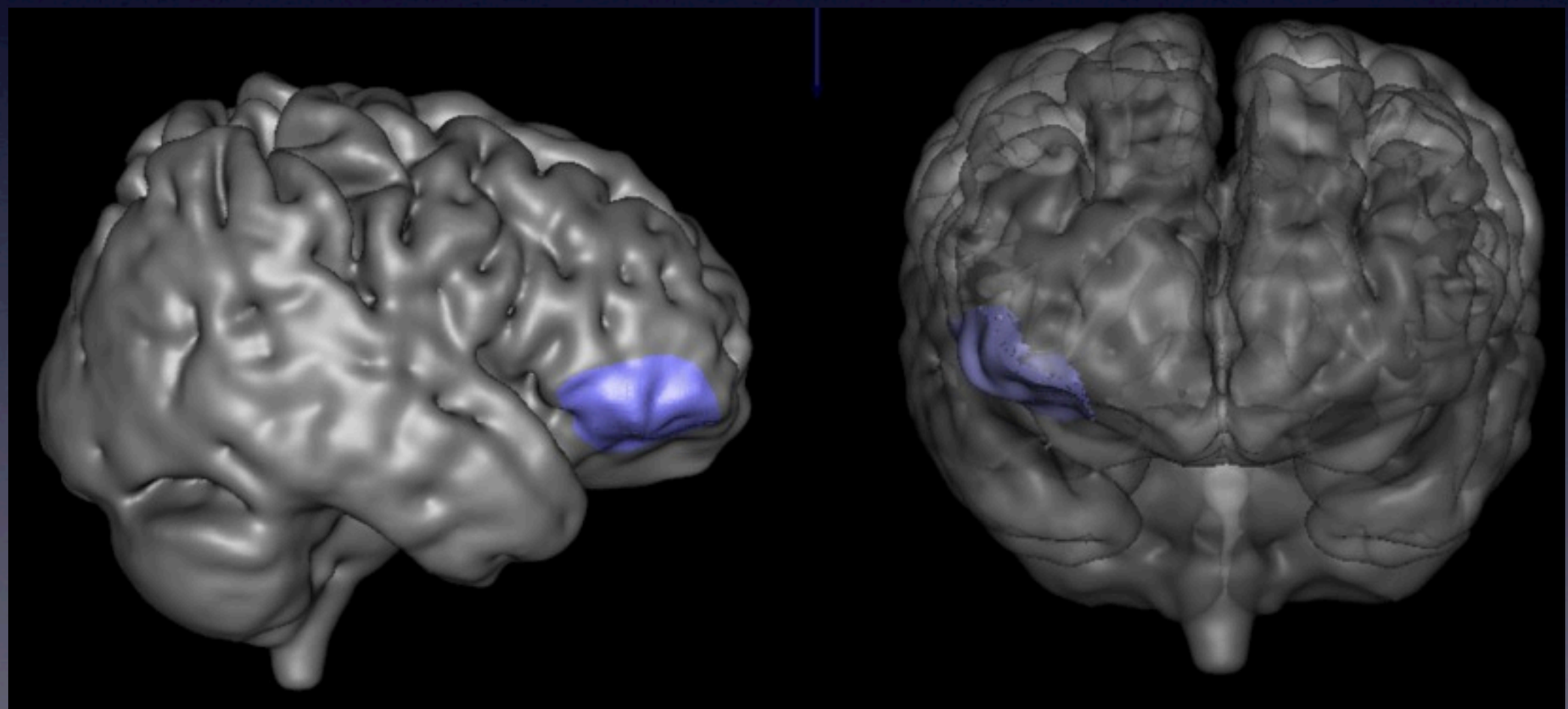
Current Optimization



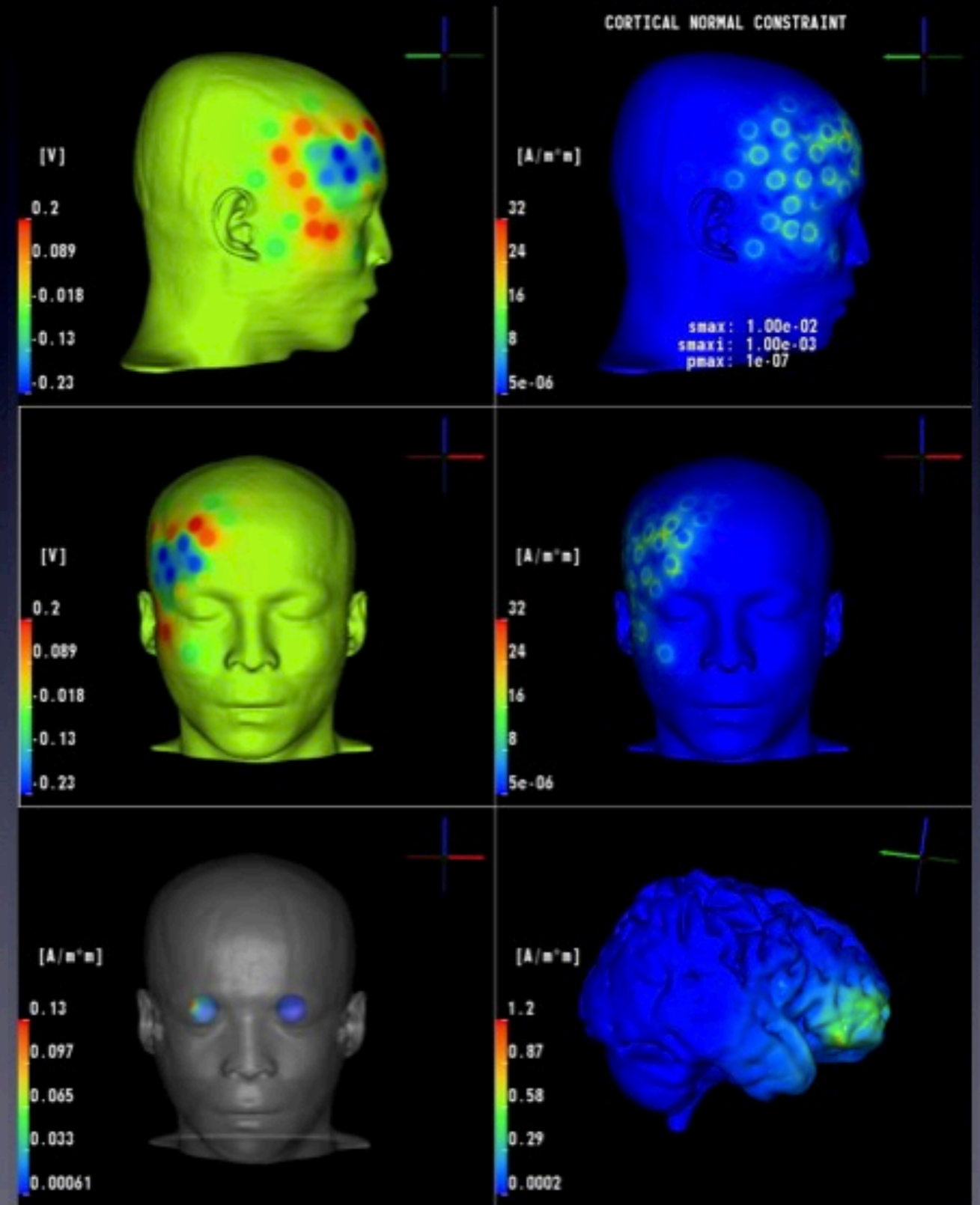
Simulation to optimize the system

Mood disorder: Depression

- Broadman area 47



Stimulation of BA 47



Summary

- tDCS/TMS are growing stimulation techniques
- SCIRun provides simulation environment