

Case Study 5

# Simulation of Bioelectric Fields: Cardiac Defibrillation and Transcranial Stimulation

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Cardiovascular Research and Training Institute (CVRTI)



## CVRTI

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Nora Eccles Harrison Cardiovascular Research and Training Institute  University of Utah

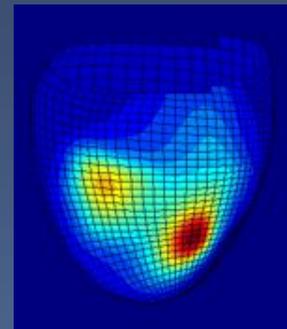
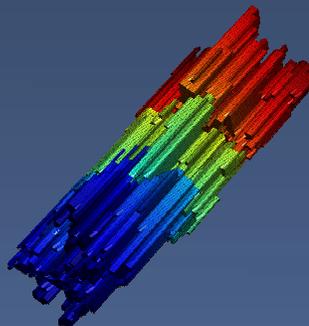
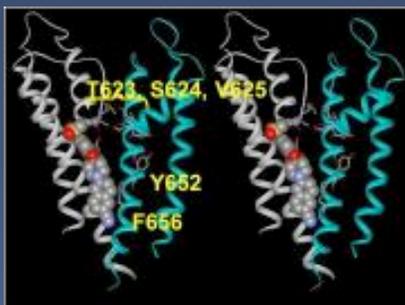
Molecular



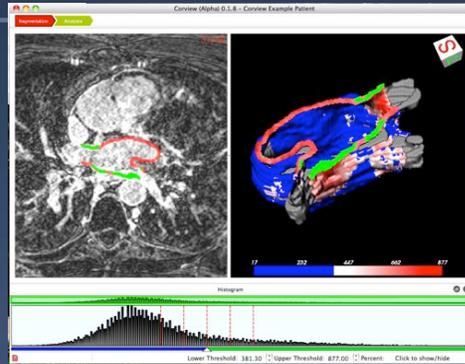
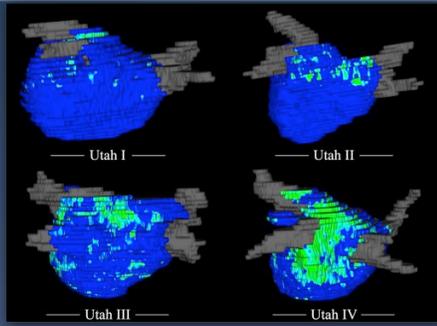
Cellular



Whole Organ



# CARMA

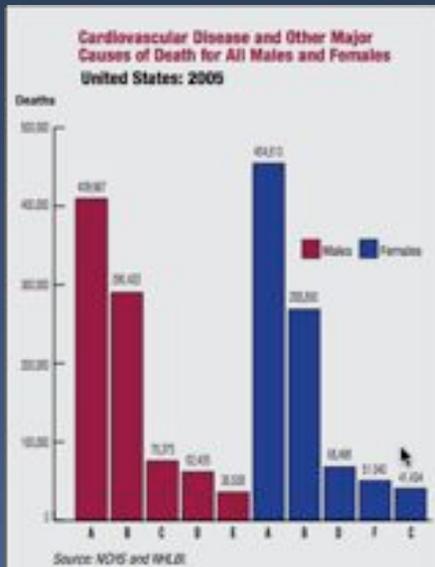


5



# Heart Disease is a Killer

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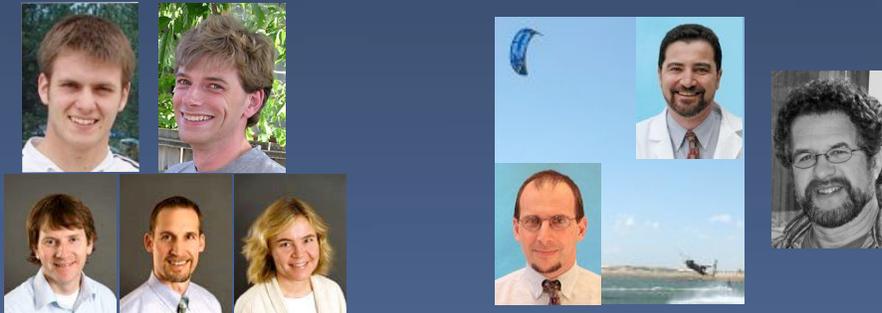
Males	
CVD+Congenital Cardiovascular Defects	A
Cancer	B
Accidents	C
Chronic Lower Respiratory Disease	D
Diabetes	E

Females	
CVD+Congenital Cardiovascular Defects	A
Cancer	B
Chronic Lower Respiratory Disease	D
Alzheimer's	F
Accidents	C



# Simulation of Defibrillation in Children

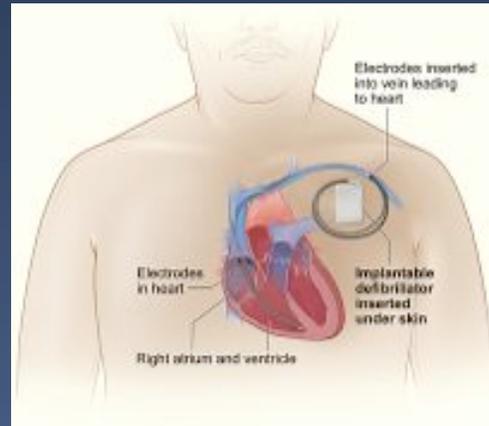
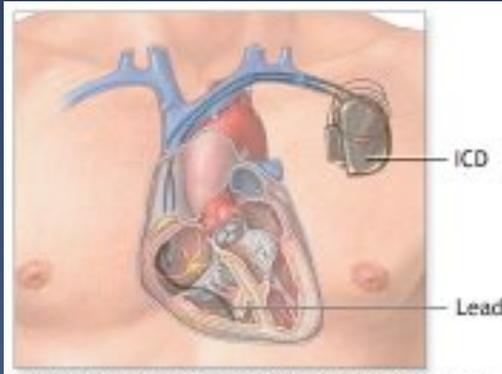


# Defibrillation in Action



# Implantable Cardiac Defibrillators (ICD)

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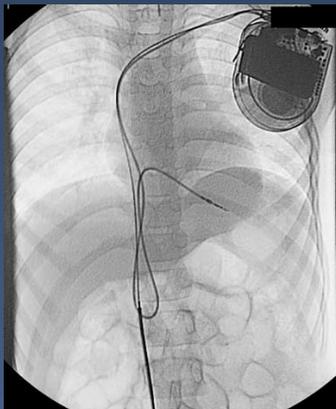


68,000 adult cases  
annually in the US (2004)

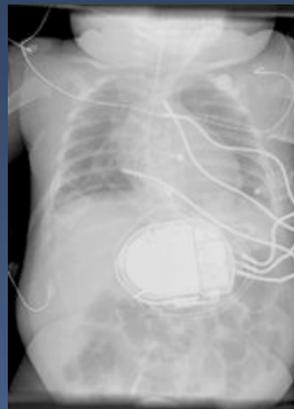


# Ad Hoc Configurations in Children

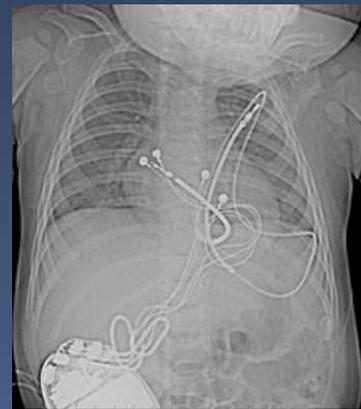
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Gasparini, JCE, 2005



Stephenson, JCE, 2006



CHB Case



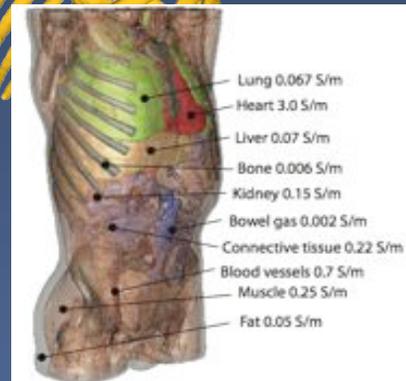
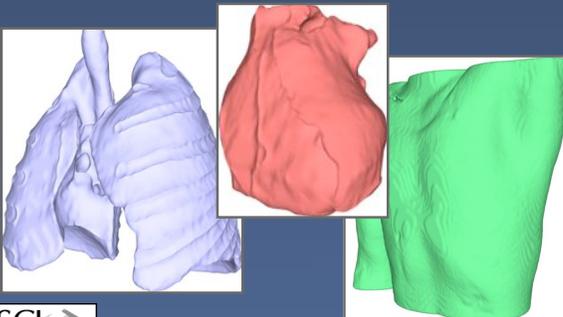
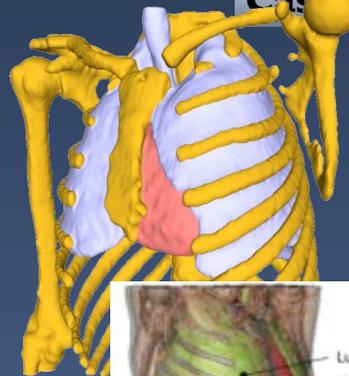
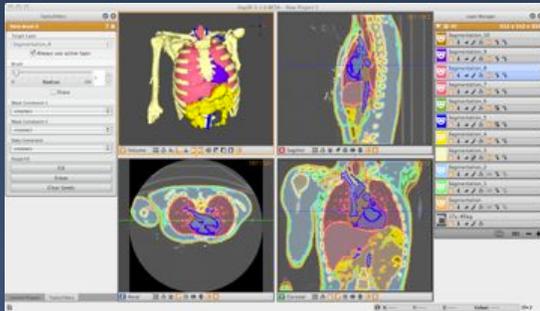
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Goal:  
Help Pediatric Cardiologists optimize  
and customize placement of ICD.



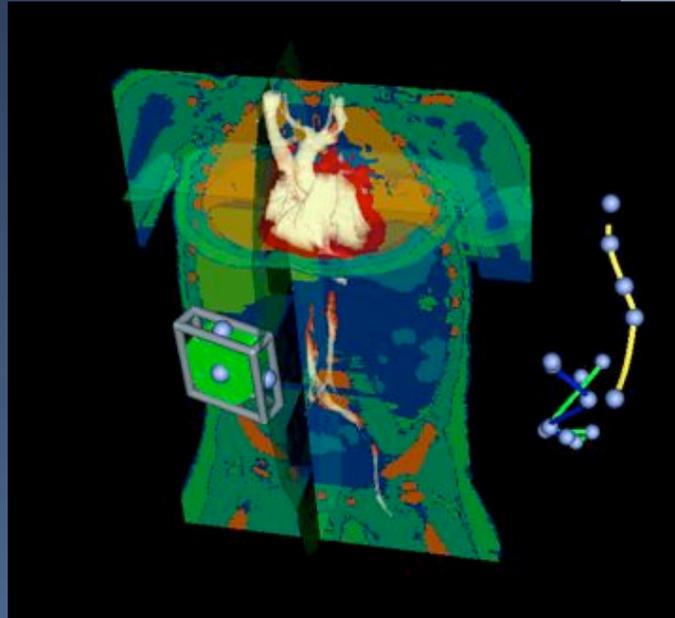
## Make Models

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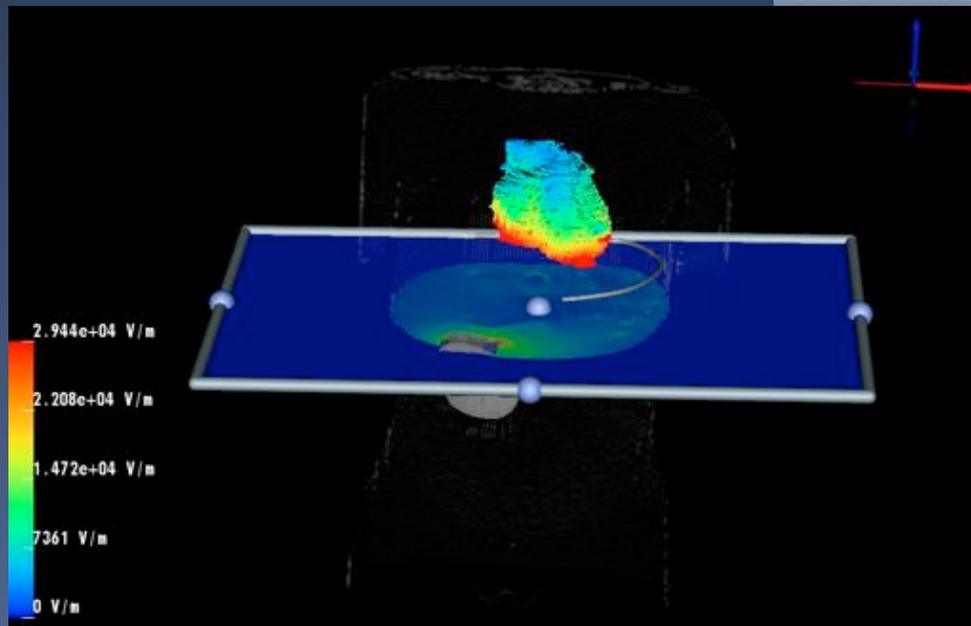
# Interactive ICD Placement

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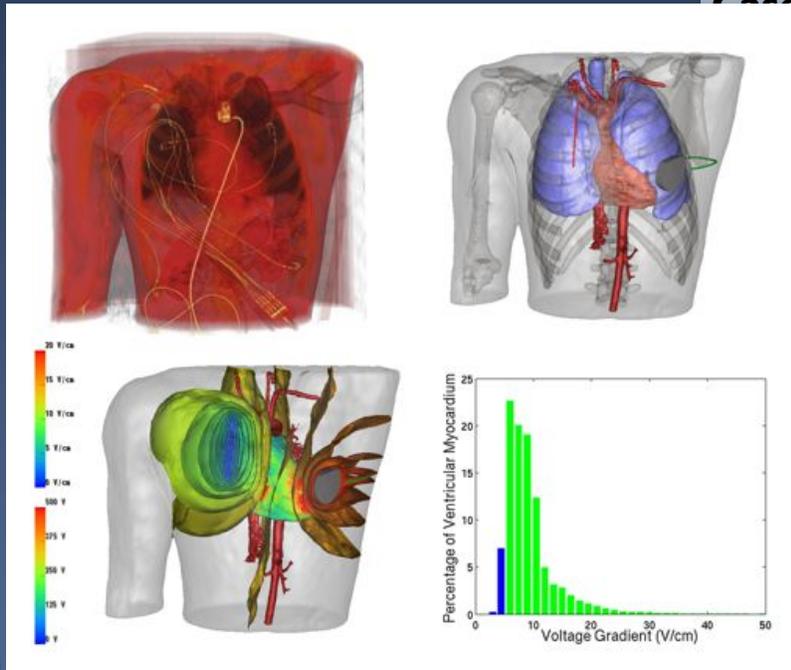
# Calculate Voltages

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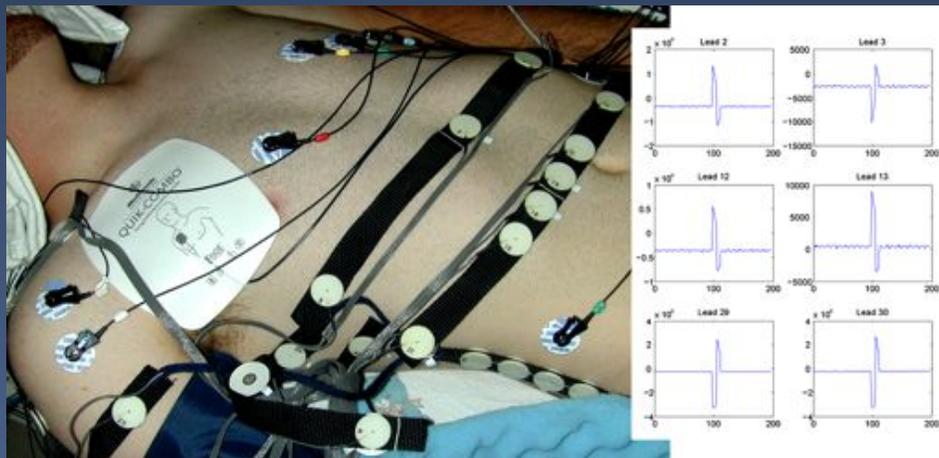
# Report Results

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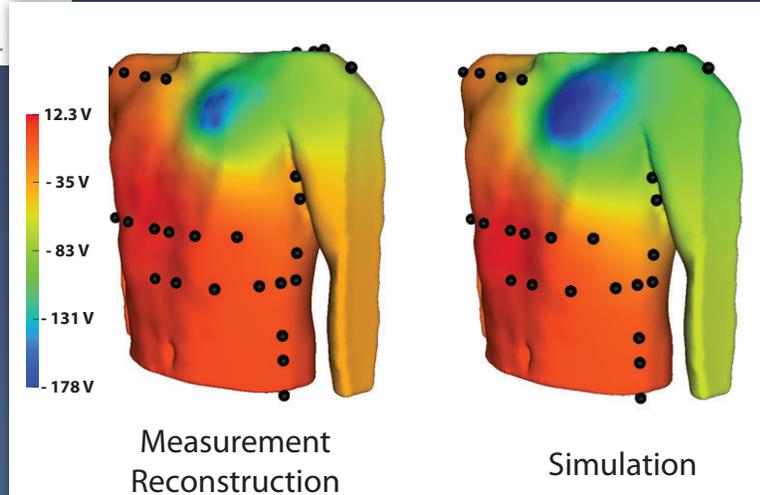
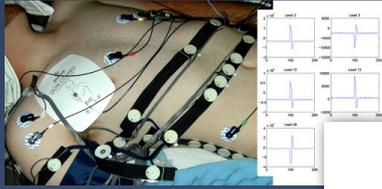
# Validation

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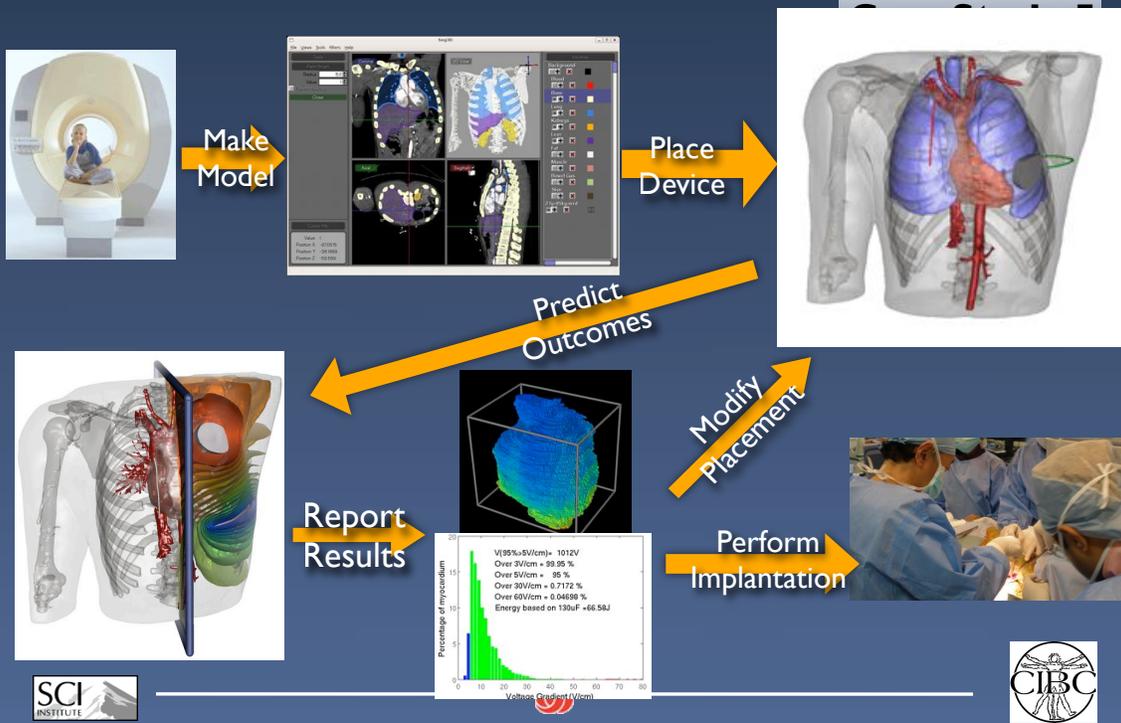


# Validation

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# The Future



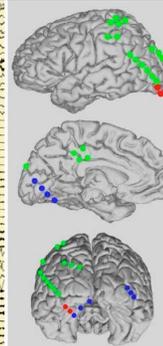
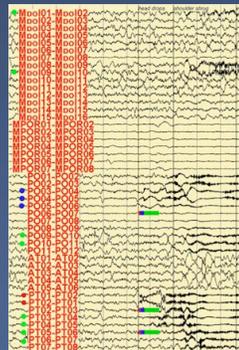
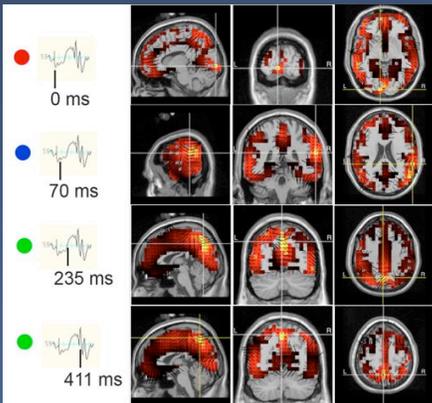
# Transcranial Brain Stimulation



## Don Tucker

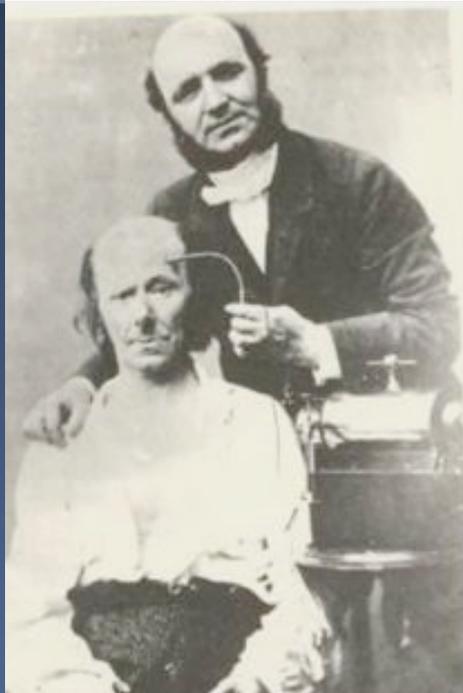
UNIVERSITY OF OREGON

Department of Psychology



# “Faradization”

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Duchenne de  
Boulogne  
(1806-1875)



# Transcranial Stimulation: Beginnings

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Sylvanus P. Thompson,  
1910



# Transcranial Stimulation: Modern Era

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Anthony Barker,  
1985

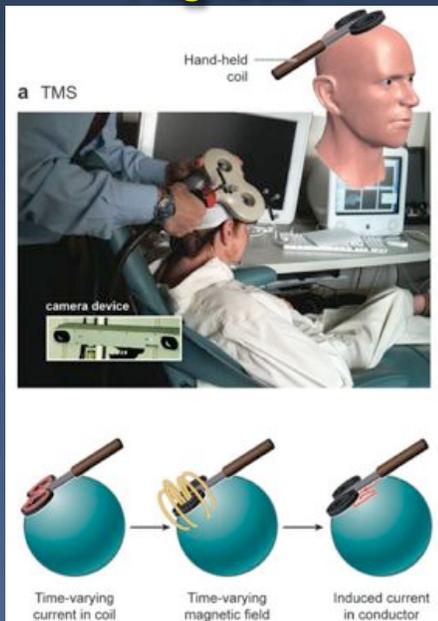


# Stimulation Approaches

## Magnetic

## Electric

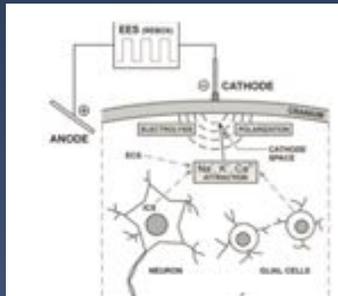
## Case Study 5



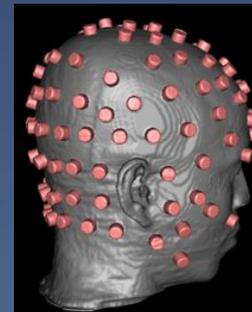
# tDCS Goals

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Clinical Goal

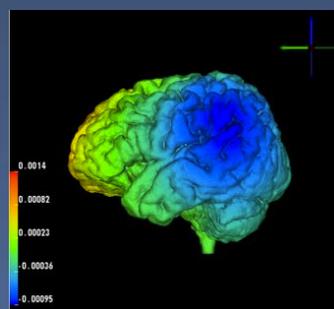
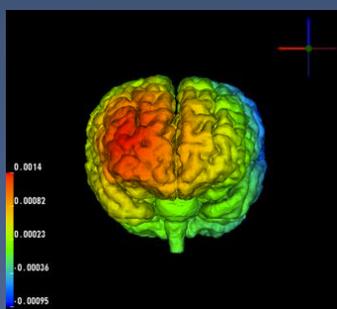
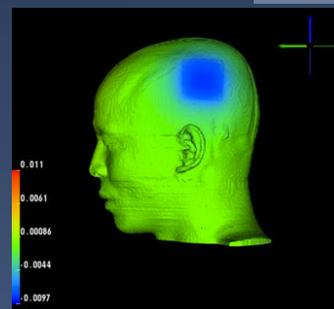
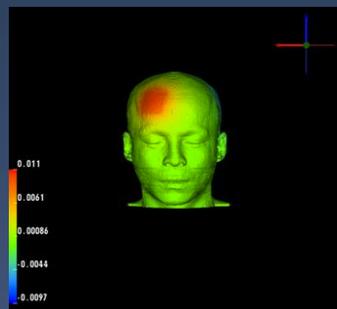


Technical Goal



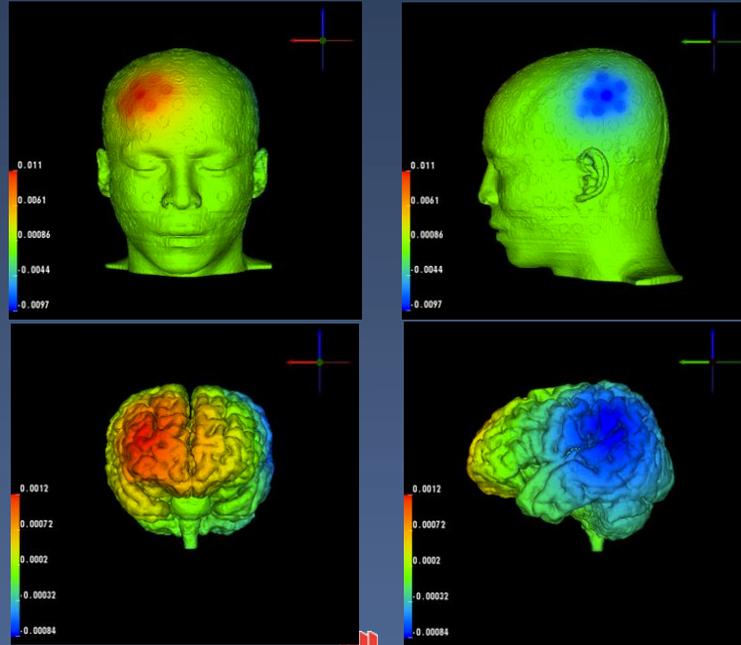
# Patch Electrode Results

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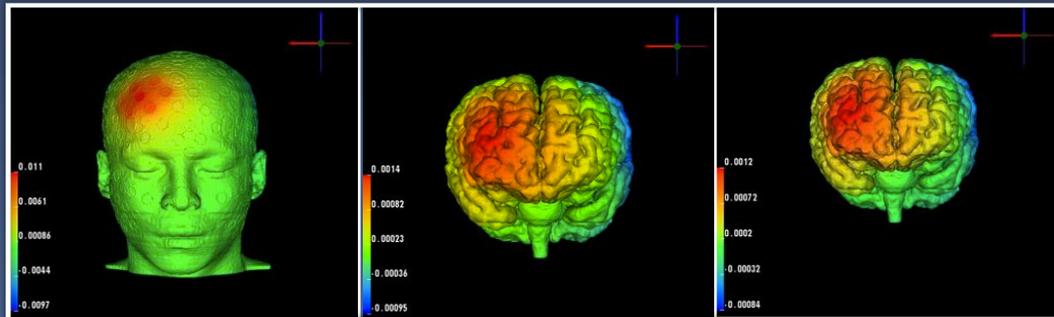
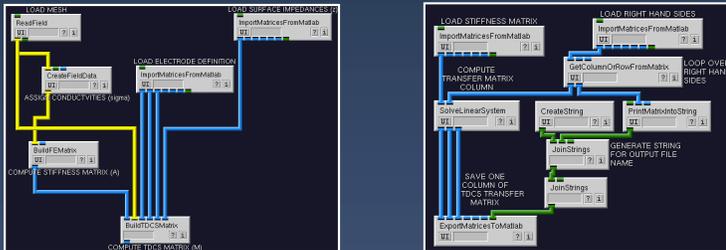
# Electrode Array Results

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# tDCS Current Status

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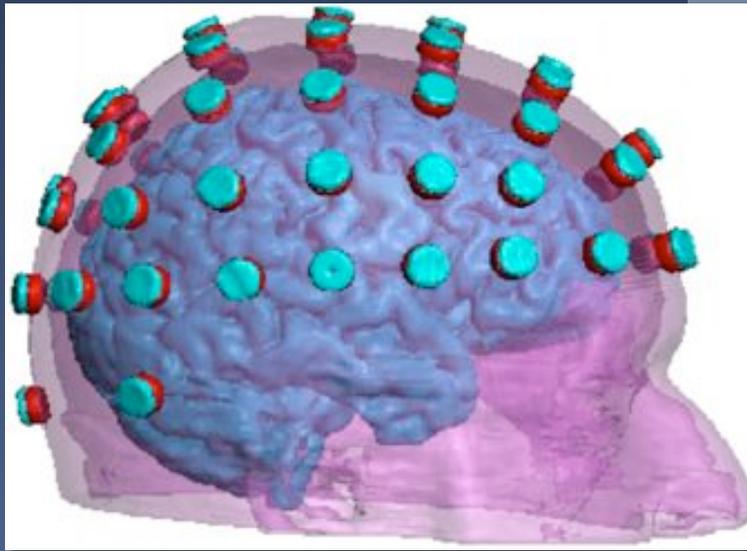
Patch

Array



# Optimization Goals (Future)

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Simulation to optimize the system



# The Tools

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