Intracranial EEG Phantom for Brain Stimulation Studies

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Client: Dr. Raheel Ahmed

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Advisor: Dr. Paul Campagnola

Team:

Avery Schuda *(Team Leader)*

Lilly Mackenzie *(Communicator)*

Helene Schroeder *(BSAC)*

Orla Ryan *(BWIG)*

Corissa Hutmaker *(BPAG)*

Problem statement

Intracranial electroencephalography (iEEG) is routinely used in surgical planning for individuals with uncontrolled seizures. Transcranial magnetic stimulation (TMS) may provide complementary information for mapping out critical brain regions that should be avoided during surgery, however, there are still safety concerns around the use of TMS in patients with iEEG. The major safety concerns are the induction of electrical currents, heating, and displacement of the implanted electrodes. The goal of this project is to develop a phantom that can be used to simulate the effect of TMS on electrode currents, temperatures, and changes in position.

Brief status update

This week the team met with Dr. Christian Franck about the work his lab does with brain phantoms. He uses a similar technique for processing and 3D printing skulls from CT scans and suggested helping the team fabricate the brain out of gelatin using his lab's protocol since they have characterized it fully using rheology experiments. We created some gelatin hydrogels to test alongside our existing agar gels using a thermocouple system. Additionally, shrink-swell tests were performed on the agar hydrogels.

Difficulties / advice requests

N/A

Major team goals for the next week

1. Meet with Dr Franck's lab to learn about various processes that could aid in the creation of our model
2. Perform temperature testing on gels
3. Work on final deliverables (poster and final report)
4. Decide on final hydrogel composition

Next week's individual goals

- Avery
    - Work with Dr Franck's lab to learn how they process brain and skull scans into 3D models
    - 3D print box phantom
    - Assist team with testing and creation of gels
- Lilly
    - Complete thermal conductivity testing of gelatin gels
    - Establish final gel composition for final poster
    - Work on final deliverables
- Helene
    - Work on final deliverables
    - Test the gels for thermal conductivity
- Orla
    - Assemble a circuit for use in thermal conductivity testing
        - Thermocouple, thermistor, or otherwise
    - Help with gel testing
- Corissa
    - Finalize thermocouple circuit
    - Perform thermal conductivity testing on agar and gelatin gels
    - Make substantial progress on final deliverables

Timeline

Task	Sept				Oct					Nov				Dec	
	5	12	19	26	3	10	17	24	31	7	14	21	28	5	10
Project R&D															
Empathize	X	X													
Background		X	X	X	X	X									
Prototyping						X	X	X	X	X					
Testings								X	X	X	X	X			
Deliverables															
Progress Reports		X	X	X	X	X	X	X	X	X	X	X			
PDS			X												
Prelim Presentation					X										

Final Poster															
Final Report/Notebook															
Meetings															
Client		X			X			X							
Advisor	X	X	X	X	X		X	X		X	X	X			
Website															
Update	X	X	X	X	X	X	X	X	X	X	X	X			

Filled boxes = projected timeline
X = task was worked on or completed

Previous week's goals and accomplishments

- Avery
  - Processed CT scans and created CAD model
  - Attended meeting with Dr. Franck
  - Created gelatin hydrogels for testing
- Lilly
  - Shrink/swel tested the agar hydrogels
  - Created gelatin hydrogels for thermal conductivity testing
  - Met w Dr. Franck to discuss project future
- Helene
  - Completed shrink/swell testing on the agar gels
  - Worked on final deliverables
- Orla
  - Met with Dr. Franck about brain tissue hydrogels
  - Attended Dr. Nimunkar's office hours for assistance
  - Worked on final deliverable sections
- Corissa
  - Met with Dr. Franck and learned about the brain phantoms made in his lab
  - Went to Dr. Nimunkar's office hours to borrow LT1025 cold junction
  - Started putting together thermocouple circuit

Current design

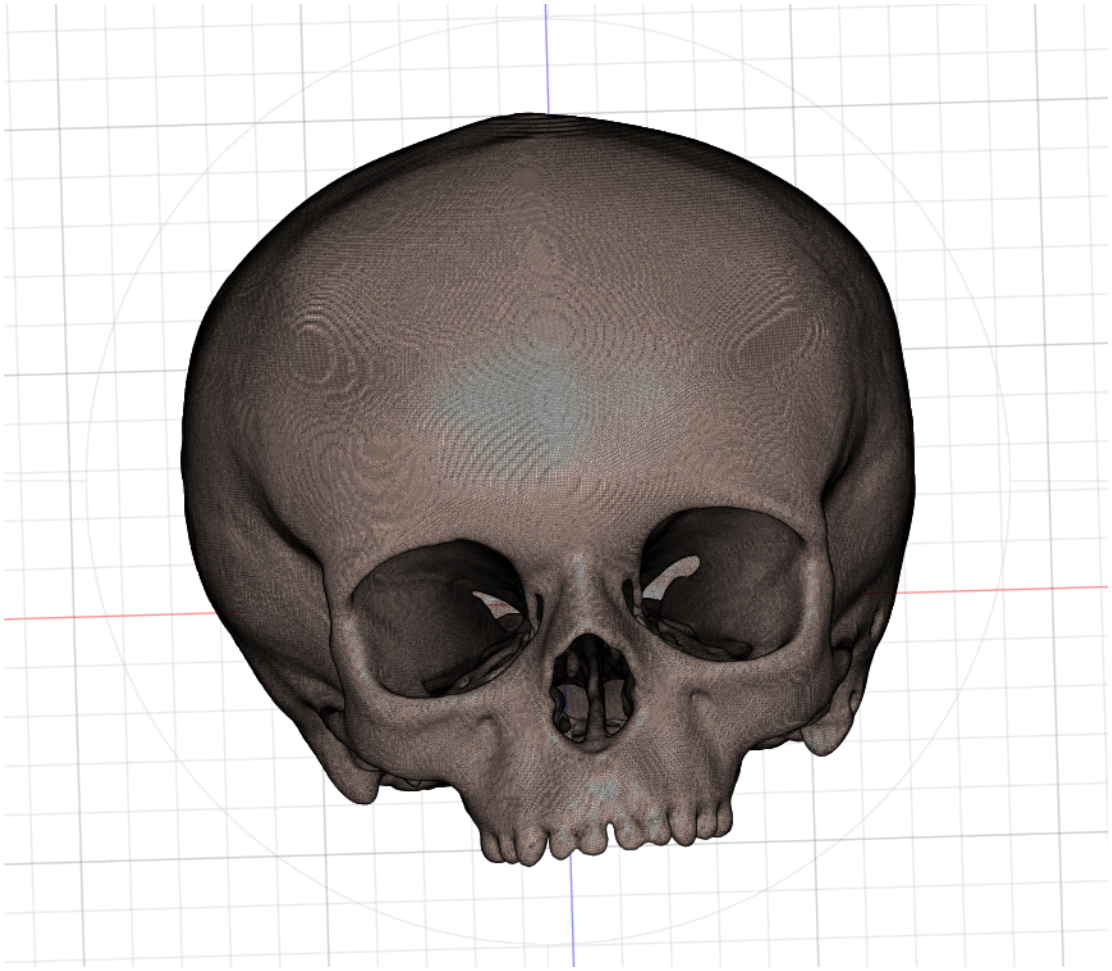

Figure 1: CAD model of pediatric skull created from CT scan

Materials and expenses

Item	Description	Manufac-turer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
3D prints										
Formlabs BioMed Clear Sample Swatch	Step wedge with thicknesses of 0.1, 0.2, and 0.3 inches for prelim presentation prop	UW Design and Innovation Lab	N/A	N/A	N/A	10/1	1	$7.14	$7.14	
									$0.00	
Hydrogel Materials										
Agar	500g of agar powder	Thermo	A107	Thermo	A1075	10/20	1	$128.6	$149.15	https://www.t

Powder, 500g	for initial brain phantom fabrication	Fisher Scientific	52.36	Fisher Scientific	2.36			5		hermofisher.com/order/catalog/product/A10752.36
									$0.00	
								TOTAL:	**$156.29**	