

Title: 3D Printed Respiratory Motion Phantom PgR

Date: 10/21/2026

Client: Dr. Andrew Shepard, Dr. Jordan Slagowski

Advisor: Prof. Mehmet Orman

Team:

Student 1: Matthew Niemuth - Team Leader

Student 2: Royal Swick - Communicator

Student 3: Drew Kruse - BSAC

Student 4: Natalie Waibel - BWIG

Student 5: Avi Ganti - Co-BPAG

Student 6: Jahan Ingraham - Co-BPAG

Problem statement: Design and Fabricate a 3D-printed respiratory motion phantom insert that simulates two lung lesions with realistic density and anatomy for evaluation of real-time tumor tracking during radiotherapy.

Brief status update: We have received the CT scan data from the client, allowing us to move forward with selecting and finalizing the specific 3D printing densities (HU to infill mappings) for the lung and tumor core. To maximize efficiency, we divided our team into two focused sub-groups: one group is leading the CAD modeling in SolidWorks and physical fabrication/3D printing of the phantom, while the second group is actively researching methods to automate the segmentation and density-mapping process for future datasets.

Difficulties / advice requests: N/A

Current design: Automated Standardized Insert System

Materials and expenses:

Item	Description	Manufac-turer	Mft Pt#	Vendo r	Vendo r Cat#	Date	#	Cost Each	Total	Link
Category 1										
									\$0.00	
									\$0.00	
Category 2										
									\$0.00	
									\$0.00	
								TOTAL:	\$0.00	

Goals

Major team goals for the next week

1. Have a phantom prototype 3D printed and ready for show and tell.
2. Look into the calibration curve for HU units and density from clients to understand what densities we should 3D print our phantom and tumor inserts out of.
3. Being looking into a python script to automate our process of printing tumor inserts.
4. Look into printing with resin and SLA

Next week's individual goals

- Royal Swick
 - I want to finish sketching out a full final design including varying densities so that we can show it to our clients and move forward with prototyping our final design, look into automating the process, and check if we could print with a resin on an SLA printer.
- Matthew Niemuth
 - Make sure we have a prototype to show for show and tell. Begin looking into how to code for automating the process. Essentially just begin building the actual project.
- Drew Kruse
 - I will play a part in getting our prototype cadded up and printed by Friday for show and tell. We will split up to work on the different parts of the phantom and work together to make sure that all fit together seamlessly.
- Natalie Waibel
 - Design and CAD the prototype so it can be printed for the Show and Tell. Complete the Intro to Machining Lathe and Mill training in person.
- Jahan Ingraham
 - Begin CAD fabrication and learn to work in solid works. I am familiar with onshape but I need to learn solidworks as well. I also have to look into what we can do for automation in Bambu Labs with AI or set code. I also need to complete the milling process to finish the machine training.
- Avi Ganti
 - Use SolidWorks to begin designing the phantom itself including all its moving parts. Continue to familiarize myself with BambuLabs so that everyone is able to understand the density considerations. Use client data from samples to assign densities to each part.

Timeline:

Task	Sep			Oct					Nov				Dec	
	12	19	26	3	8	17	24	31	7	14	21	28	5	10
Project R&D														
Research	X	X	X	X	X	X								
Design			X	X	X	X								
Prototyping				X	X	X								
Testings														
Deliverables														
Progress Reports	X	X	X	X	X	X								
PDS		X												
Design Matrix			X											
Prelim Presentation				X										
Prelim Report					X									
Final Poster														
Final Report														
Meetings														
Client		X		X										
Advisor	X	X	X	X	X	X								
Website														
Update														

Filled boxes = projected timeline

X = task was worked on or completed

Detailed accomplishments

Previous week's goals and accomplishments

- Royal Swick:
 - Previous Goals: I wanted to sketch a final design with regions listing the density values we will use, look into automating the process, and use a lung tumor from a public dataset in bambu studio.
 - Accomplishments: I was able to find a public dataset on 3d slicer and uploaded the tumor into bambu studio, where I ran it through the same process and it was successful. I also communicated with the clients throughout the week, and helped split our team into subgroups. I made a sketch of the final design however it is not completely done and I have not sent it to the clients yet.
- Matthew Niemuth
 - Learn how to use Bamboo Lab to overlay tumors with a tumor insert to print out. Split the team into teams that focus on the 3D model of the phantom and then another group for working on the code to automate the procedure. Then begin working on developing the prototype
 - Accomplishments: This week I completed my training. Since I already had Human Subject training done from 201, I completed HIPPA training. I also helped split our team into sub teams

for the physical prototype and the software side of creating a script that will help automate our process. Finally, we got a calibration curve from the client for HU units and density which will help us decide based on CT scans what density to print different tumors out of. I also updated some things in lab archives like progress reports.

- Drew Kruse
 - Previous Goals: To adjust our 3D printing process as needed to achieve the density of material that our client wants. We will also make sure the shape of our design fits within the size parameters. We will look into printing the other whole phantom prototype once we get the ct scans back from the client.
 - Accomplishments: This week I did some research on how we can use solidworks to make the prototype that we will bring to show and tell next week. We have reviewed the data that our client gave us from the test CT scan for the densities of the materials. I attended the client meeting to talk about the design we chose and what our steps are moving forward.
- Jahan Ingraham
 - Previous Goals: Complete training due next week and look into which specific roles in CAD design and fabrication we will take on.
 - Accomplishments: Completed lab training such as Biosafety lab training and The OSHA Lab Standard. Started deciding tasks with fabrication of each part and how we will communicate to make sure the parts work and fit together well. I also completed the online lath and milling training online and went in person to do the lathing portion.
 -
- Natalie Waibel
 - Previous Goals: Once we confirm the standard tumor insert dimensions, I want to draw out all the design parts and make a 3D model of the phantom in Solidworks or Onshape to ensure everything fits together properly.
 - Accomplishments: Finished the canvas course for machine training and registered for the class next week. Learned more about BambuLab and SolidWorks. Sketched out the design but have yet to input it into SolidWorks.
- Avi Ganti
 - Previous Goals: Familiarize myself with BambuLab so that I can contribute to the CAD models of the tumor inserts. Additionally, use feedback from client based on the density tests we send them to tweak any densities that we print at in the future. Work on a model of the full phantom cylinder to print ASAP so we can test compatibility with the machine.
 - Accomplishments: Began to design parts in BambuLab, delivered samples to client and looked over the data they sent back to figure out what density we need. Familiarized myself with Solidworks to begin designing project in CAD.

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
------	------	----------	----------	----------------	----------------

Matthew Niemuth	10/22/2026	○ This week I did some research on how we can use solidworks to make the prototype that we will bring to show and tell next week. We have reviewed the data that our client gave us from the test CT scan for the densities of the materials. I attended the client meeting to talk about the design we chose and what our steps are moving forward. I also updated some things in lab archives like progress reports.	3	3	31
Royal Swick	10/22/2026	○ I was able to find a public dataset on 3d slicer and uploaded the tumor into bambu studio, where I ran it through the same process and it was successful. I also communicated with the clients throughout the week, and helped split our team into subgroups. I wasn't able to get around to making a final sketch but I plan on doing it by this coming weekend	5	5	33

Drew Kruse	10/21/26	This week I did some research on how we can use solidworks to make the prototype that we will bring to show and tell next week. We have reviewed the data that our client gave us from the test CT scan for the densities of the materials. I attended the client meeting to talk about the design we chose and what our steps are moving forward.	3	3	28
Natalie Waibel	10/21/26	Finished the canvas course for machine training and registered for the class next week. Learned more about BambuLab and SolidWorks. Sketched out the design but have yet to input it into SolidWorks.	4	4	27
Avi Ganti	10/7/26	Discussed with team about individual roles, began to look into solidworks to complete my assigned part of the design. Analyzed data from clients regarding sample densities under the machine. Attended client meeting to discuss future work and plan out steps moving forward. Began safety training.	4	4	27
Jahan Ingraham	10/21/16	Looked into individual roles with CAD design. Completed online lab courses (Biosafety and OSHA lab standard) as well as machining training online and in person lathing portion.	7	7	32

