Title: 3D Printed Respiratory Motion Phantom PgR 8

Date: 10/28/2026

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: Both our subteams made progress this week. The Solidworks team was able to finish the CAD for the phantom and the end caps that hold it together. The software team was able to start the code as well. So far the only part that works is putting a python script within 3D slicer to get the median HU unit value of the tumor, recommend an infill density to print in, and generate the standardized cylinder insert shape in Bambu Studio, though the user would still have to input the recommended input density into Bambu studio for the tumor and standardized shape surrounding it so there is more work to do still.

Difficulties / advice requests: N/A

Current design: Automated Standardized Insert System

Materials and expenses:

Item	Description	Manufac-turer	Mft Pt#	Vendor	Vendor 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. Meet with client and show preliminary prototype and code and receive design feedback
2. Update prototype and code based on feedback from them
3. Continue to add to code completely automate it

Next week's individual goals

- Royal Swick
    - Meet with the clients hopefully sometime next week where we can update them on our progress and hopefully verify the geometry of our prototype with the QUASAR system. From there we can make improvements and next steps as needed. Refine/write steps down to automating the setup.
- Matthew Niemuth
    - Meet with clients to receive design feedback on prototype and code. Once we meet with them and see what they think, we can move forward with improving and applying their feedback to our design to work towards a final prototype for the end of the semester.
- 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
    - Meet with clients to get feedback on our progress (prototype and code). Then, we can designate next steps to improve our prototype and code.
- Jahan Ingraham
    - Refine CAD design after the first round of testing and look at how our design works right now. This can be done with tests through the clients for design feedback or testing on densities used.
- 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	X							
Design			X	X	X	X	X							
Prototyping				X	X	X	X							
Testings														
Deliverables														
Progress Reports	X	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	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 find a way to automate the process rather than having to manually create the material surrounding the tumor every time you want to test another tumor.
  - Accomplishments: I emailed with the clients to establish a sort of plan moving forward. I sketched out a prototype and some of my ideas for the final device. I worked with Matthew on automating the process in bambu using code, and to do this we used a segmented tumor from a public dataset in 3d slicer and used the python extension module, next we used AI to help us write code that would take that tumor and create an stl file with the cylinder already surrounding it so it is ready to print, rather than having to do it manually in bambu every time. Lastly, I updated lab archives
- 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.
  - Accomplishments: This week I was able to learn how to use Bambu Studio and get a start on learning how to use 3D slicer. I also began trying to figure out how to code to automate our

design process using AI. I documented the manual steps of getting a tumor into 3D slicer and generating a standardized cylindrical insert shape around it and changing their infill densities to print it out. Additionally, I also spent time getting more research entries into lab archives to catch up on that as I have been way behind.

- Drew Kruse
    - Previous Goals: To adjust our 3D printing process as needed to 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 trainings specifically lathing and milling
    - Accomplishments: Completed intro to machining specially this milling this week and designed and fabricated for show and tell.
- Natalie Waibel
    - Previous Goals: 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.
    - Accomplishments: Spent five hours working on the Lathe and Mill training. Completed the lab training. Looked into Bambu Studios.
- 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	10/29/2026	○ This week I was able to learn how to use Bambu Studio and get a start on learning how to use 3D slicer. I also began trying to figure	6	6	37

		out how to code to automate our design process using AI. I documented the manual steps of getting a tumor into 3D slicer and generating a standardized cylindrical insert shape around it and changing their infill densities to print it out. Additionally, I also spent time getting more research entries into lab archives to catch up on that as I have been way behind.			
Royal Swick	10/28/2026	○ I emailed with the clients to establish a sort of plan moving forward. I sketched out a prototype and some of my ideas for the final device. I worked with Matthew on automating the process in bambu using code, and to do this we used a segmented tumor from a public dataset in 3d slicer and used the python extension module, next we used AI to help us write code that would take that tumor and create an stl file with the cylinder already surrounding it so it is ready to print,	7	7	40

		rather than having to do it manually in bambu every time. Lastly, I updated lab archives			
Drew Kruse	10/28/26	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	10/29/26	Spent five hours working on the Lathe and Mill training. Completed the lab training. Looked into Bambu Studios.	6	6	33
Avi Ganti	10/28/26	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	10/28/16	- Completed milling portion of my training - CAD designed the cap and helped Drew and Avi with the	5	5	37

		body of the phantom. - Printed phantom parts for show and tell			