

Title: 3D Printed Respiratory Motion Phantom PgR 6

Date: 10/14/2026

Client: Dr. Andrew Shepard

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: This week our team 3D printed test print outs with different infill densities ranging from 20% to 90%. Additionally, we figured out how to use Bamboo lab to overlay the tumors within a larger standardized shape which we chose to be a cylinder. The team also was able to develop proof of concept with the 3D printers at Wendt Commons as they are able to print different parts of the print out with different infill densities. Finally, the team met with the client again this week to discuss progress and discuss the plan moving forward the next week or so as far as getting the densities tested under CT scans and prototype development.

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. Get the test print outs to the clients as early in the week as possible so they can test them under CT scans and give feedback on material and density choices for the phantom prototype before we start modeling and building it.
2. Have the whole team understand the process of using Bamboo lab to overlay the tumors within the tumor insert so we can all effectively explain the process and understand how to implement an automated procedure with it.
3. Begin diving into prototype development including Solidworks models of the phantom as well as code or software to help automate the process.

Next week's individual goals

- Royal Swick
 - I want to sketch 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. Also look into possibly automating the process.
- 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.
- Drew Kruse
 - 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 the ct scans back from client.
- Natalie Waibel
 - 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.
- Jahan Ingraham
 - Start planning out the fine details of the design and CAD fabrication either on solidworks or onshape. Once we get info back from our client about how the different densities of filming work on the radiation film. Then I will try to learn more about working in Bambu Lab to get more comfortable with the platform.
- Avi Ganti
 - 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.

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									
Design			X	X	X									
Prototyping				X	X									
Testings														
Deliverables														
Progress Reports	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									
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: Set up another meeting with our clients to discuss next steps and answer any questions we may have. Download bambu studio and ensure that it is possible to move forward with our current design.
 - Accomplishments: I set up a meeting with our clients where we talked about our progress and next steps on the project. I also did some more research on how tissue densities change throughout the lung. Lastly, I downloaded bambu studio and took our tumor stl file from our client and created a cylinder fully around it and verified that you could use different infill densities and split it in half. Also attended the team meeting on Sunday where we discussed our plans for the week.
- Matthew Niemuth
 - Look into how AI can be used to automating and standardizing processes so we can apply its use to standardizing and automating our tumor inserts. Also make sure the report is done by Monday.

- Accomplishments: I mainly focussed on getting caught up a bit on my research entries in Lab Archives as I have been bad about that. I spent some time with Royal learning the process of getting the tumor and tumor insert overlaid in Bamboo lab to 3D print in different densities, but still want to go and try it for myself. I attended the client meeting and contributed to updating them about progress, plans for the future, asking questions to help guide the design process, and taking notes during the meeting.
- Drew Kruse
 - Previous Goals: Reflect on the feedback we get from our preliminary presentation and continue to flush out the design we chose. I will complete my part of the report and hold everyone accountable for their parts.
 - Accomplishments: Completed report and did some research into how the whole system will work. Looked into the 3D printer capabilities, and found that pretty much anything is possible. Played around with Bambu and Claude because we may use this for the project. Met with client to discuss the 3D printing process and the drop off of samples.
- Jahan Ingraham
 - Previous Goals: Reflect on feedback from presentation to create a design to fabricate and test. Also to work on the preliminary report.
 - Accomplishments: Completed preliminary report sections for the intro including the Appendix and rest of intro paragraphs. Met with group to discuss working with CAD and Bambulab and running first set of testing with filiment density.
- Natalie Waibel
 - Previous Goals: Develop and finalize our final design that we chose from the feedback we received from our preliminary presentation. Look into the automating software for tumor inserts. Finish the report by Monday. Meet with group to discuss final design.
 - Accomplishments: Completed the report and did some research on plastic hinges and snaps to then implement into the 3D printed design once we split up into groups.
- Avi Ganti
 - Previous Goals: Look over peer feedback and complete the reflection on how I can contribute to the team more. Research more about automating CAD design to start working on design 3. Finish preliminary report.
 - Accomplishments: Completed the first two designs in the preliminary report, as well as compiled and cited all of our references for our works cited. Began to look at BambuLab as well as automating CAD design using python/Claude. Met with clients to discuss our progress as well as address any questions going further.

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Matthew Niemuth	10/14/2026	○ I mainly focussed on getting caught up a bit	4	4	28

		on my research entries in Lab Archives as I have been bad about that. I spent some time with Royal learning the process of getting the tumor and tumor insert overlaid in Bamboo lab to 3D print in different densities, but still want to go and try it for myself. I attended the client meeting and contributed to updating them about progress, plans for the future, asking questions to help guide the design process, and taking notes during the meeting.			
Royal Swick	10/7/2026	I set up a meeting with our clients where we talked about our progress and next steps on the project. I also did some more research on how tissue densities change throughout the lung. Lastly, I downloaded bambu studio and took our tumor stl file from our client and created a cylinder fully around it and verified that you could use different infill densities and split it in half. Also attended the team meeting on Sunday where we discussed our plans for the week.	6	6	28
Drew Kruse	10/14/26	Completed portion of the report and did some research into how the whole system will work. Looked into the 3D	5	5	25

		printer capabilities, and found that pretty much anything is possible. Played around with Bambu and Claude because we may use this for the project. Met with client to go over the 3D printing capabilities and process. Confirmed			
Natalie Waibel	10/15/26	Completed the report and did some research on plastic hinges and snaps to then implement into the 3D printed design once we split up into groups. The snap fit design for both the hinge and the closing mechanism is looking the most promising for plastic 3D printing capabilities and durability.	4	4	23
Avi Ganti	10/7/26	Looked over client and peer feedback, completed designs and references in report, installed and played around with BambuLab, researched how to automate CAD design with python, as well as varying densities within a print. Met with clients to answer questions they had about the 3D printing process, talk about future plans, as well as ask about any more requirements they might have.	4	4	23
Jahan Ingraham	10/15/16	Looked over peer review feedback, looked at CAD design and Bambulabs. Met with the group to discuss client meetings and steps moving forward. I also worked on the preliminary report doing the entire intro portion.	6	6	25

