

Title: 3D Printed Respiratory Motion Phantom PgR 2

Date: 9/16/2026

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, the team completed the initial draft of the Product Development Specification, defining key constraints for performance, safety, and fabrication. The team also conducted research on the overall project scope, focusing on how simulating realistic, multi-tumor geometries will help researchers evaluate real-time tumor tracking. The PDS establishes candidate materials like PLA-LW and PLA+ to mimic lung and tumor densities on CT scans. This prepares the team for the September 23rd meeting with Dr. Shepard to view both the QUASAR setup and other phantoms in person.

Difficulties / advice requests: No difficulties to discuss at this time.

Current design: N/A

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. Continue to conduct research into respiratory phantoms, potential 3D printing materials, and radiotherapy techniques involving CT scans.
2. Meet with Dr. Shepherd to get dimensions of the phantom, and to see how the phantom will have to integrate with the QUASAR system.
3. Begin to sketch possible designs for both the phantom and the tumors, and begin to construct a design matrix.

Next week's individual goals

- Royal Swick
 - Meet with Dr. Shepherd next Wednesday and get dimensions on the phantom and a better idea of how the phantom integrates with the QUASAR system. Find specific materials to be used for the phantom and the tumors, research how they will integrate together, and look at places to order the materials.
- Matthew Niemuth
 - Continue to conduct more research on respiratory phantoms, radiotherapy techniques, and materials. Meet with Dr. Shepard on Wednesday to learn more about and ask questions regarding the phantom's integration with the QUASAR system and other radiotherapy technology involved in Lung Cancer treatment.
- Drew Kruse
 - Keep learning about the project and informing each other, so we can all have a comprehensive idea of the whole system as well as the small part of the system we will be working on exclusively. After completing extensive research on competing designs and standards, I think I will be able to help brainstorm compliant designs for our presentation.
- Natalie Waibel
 - Meet with Dr. Shepherd on Wednesday to get dimensions of the phantom and a better understanding of the QUASAR system's role in medicine. Research materials to use in our design. Start a rough design of the product.
- Jahan Ingraham
 - Begin designing sketches for the lung phantom and organic replica tumors to work well with the specific dimensions of the QUASAR system. Continue researching the materials and techniques required to make the system natural and organic compared to current phantoms.
- Avi Ganti
 - Meet with Dr. Shepard to ask specific questions to further my understanding of the QUASAR system. Sketch preliminary designs to figure out dimensions and costs of potential materials. Meet with the team to make sure everyone is on the same page.

Timeline:

Task	Sep			Oct					Nov				Dec	
	12	19	26	3	8	17	24	31	7	14	21	28	5	10
Project R&D														
Research														
Design														
Prototyping														
Testings														
Deliverables														
Progress Reports														
PDS		X												
Design Matrix														
Prelim Presentation														
Prelim Report														
Final Poster														
Final Report														
Meetings														
Client		X												
Advisor	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: Research more about the project and become familiar with the larger scope of the project. Complete my portion of the PDS.
 - I completed my portion of the PDS, which included the size, weight, materials, aesthetics, appearance, and finish. I also spent time gaining a deeper understanding of the project's overall scope, learning how simulating multiple lung tumors for real-time external beam radiation therapy will enable researchers to advance dynamic beam-tracking techniques and ultimately improve treatment precision for cancer patients.
- Matthew Niemuth
 - Previous Goals: Conduct more research on respiratory phantoms and radiotherapy techniques. Begin the PDS to complete by next Thursday.

- Accomplishments: I completed research that helped me complete my part of the PDS. A large part of that was mainly reflecting on the initial client meeting last week and figuring out the scope of the project and client requirements, so really not much research was involved in that. Other than that I added one research entry to my notebook. I wanted one more but with the Career fair everyday this week on top of other classes it was very difficult for me to find time to accomplish my goals from last week.
- Drew Kruse
 - Previous Goals: Learn as much as I can about the project, so we will be able to brainstorm some designs and start working on our PDS and our presentation.
 - Accomplishments: Very research heavy week. I learned a ton more about competing designs and different standards and specifications that our designs will have to be compliant with. I finished my portion of the PDS and helped polish the rest.
- Jahan Ingraham
 - Previous Goals: Continue research on the lung phantom specifically how to realistically print tumor density.
 - Accomplishments: Continued research on the respiratory lung phantom and completed a portion of the Product Design Specifications document such as the “Product Characteristics,” and “Miscellaneous” sections.
- Natalie Waibel
 - Previous Goals: Continue research on lung phantom and complete PDS.
 - Accomplishments: Conducted research on the QUASAR system and how the phantom can replicate lung tissue effectively. Worked on PDS.
- Avi Ganti
 - Previous Goals: Continue research on the functionality of the QUASAR phantom and radiotherapy techniques.
 - Accomplishments: Researched a lot about the reliability of the phantoms and the specific types of tumors they can analyze. Found legislation regarding safety measures and requirements we will need to follow both in the product we make as well as when we use the system.

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Matthew Niemuth	9/16/26	This week I reviewed notes on the client meeting to list out client requirements and write the function statement on the PDS. I also spend a little bit of time researching about the use of the QUASAR system in regards to tracking the motion of lung lesions.	4	4	4
Royal Swick	9/16/26	This week I completed my portion of the	4	4	7

		PDS, filled out the progress report, and conducted research to better understand the scope of the project.			
Drew Kruse	9/17/2026	- Conducted research about competing designs and standards - Learned more about the purpose of the machine and project. - Finished PDS and progress report	4	4	6
Natalie Waibel	9/17/26	Conducted research on QUASAR system and effective phantoms, and worked on PDS.	4	4	6
Avi Ganti	9/17/26	This week I researched about the functionality and safety of the QUASAR phantom and contributed those findings to the PDS. I filled out the physical characteristics, safety, and accuracy and reliability sections, as well as my part of the progress report.	4	4	6
Jahan Ingraham	9/16/16	Completed PDS (Product Characteristics & Miscellaneous). Reviewed and continued research on replicating tumor density. Completed progress report.	4	4	6