

# Title: Radiographic Radiomics Phantom Progress Report 7

Date: 10/17 - 10/22

Client: Dr. Jennie Crosby

Advisor: Yang Lu

Team:

| Last Name | First Name | Role         | E-mail                            | Phone          | Office Room/Building |
|-----------|------------|--------------|-----------------------------------|----------------|----------------------|
| Trapskin  | Pierson    | Leader       | <a href="#">Pierson Trapskin</a>  | (608) 335-7986 |                      |
| Hodgson   | Ava        | Communicator | <a href="#">Ava Hodgson</a>       | (289) 968-7479 |                      |
| Stellflue | Presley    | BSAC         | <a href="#">Presley Stellflue</a> | (847) 224-7803 |                      |
| Pionek    | Sonja      | BWIG         | <a href="#">Sonja Pionek</a>      | (608) 622-2590 |                      |
| Casas     | Matthew    | BWIG         | <a href="#">Matthew Casas</a>     | (262) 290-8734 |                      |
| Ma        | Allie      | BPAG         | <a href="#">Allie Ma</a>          | (781) 990-8825 |                      |

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## Problem Statement

The goal of this project is to design and construct a radiomics benchmarking phantom for radiographic imaging systems that includes multiple clinically relevant textures, accommodates both small- and large-anatomy imaging protocols via a removable core or interchangeable sizing, and uses materials stable enough for repeated use over multiple years.

## Brief Status Update

This week the team focused on planning our fabrication process which will continue over the next few weeks before show and tell. We are still waiting for our client to provide us with confirmation of the grant proposal so we can accurately plan based of our budget.

## Difficulties / Advice Requests

Do you have an updated budget from the grant committee?

## Current Design

The phantom features a removable core, allowing the same shell to represent both large and small anatomy by swapping in modular phantom texture inserts. Phantom materials and textures are still undecided, but shall mimic either the physical texture or electron density of anatomical tissues.

## Materials and Expenses

| Item                      | Description                                                           | Vendor    | Part #   | Qty | Cost each [\$]   | Total [\$] |
|---------------------------|-----------------------------------------------------------------------|-----------|----------|-----|------------------|------------|
| Cast acrylic blank, shell | Clear cast PMMA, 410 × 310 × 165 mm (or bonded slabs)                 | [TBD]     | [TBD]    | 1   | \$440-1,130 est. | 600        |
| Cast acrylic blank, core  | Clear cast PMMA, 190 × 190 × 165 mm                                   | [TBD]     | [TBD]    | 1   | 130-320 est.     | 200        |
| Weld-On 40 cement         | Two-part reactive acrylic cement, 1 pt kit (only if slabs are bonded) | ePlastics | IPS40-PT | 1   | 46.71            | 46.71      |

|                            |                                          |                      |       |       |              |         |
|----------------------------|------------------------------------------|----------------------|-------|-------|--------------|---------|
| PLA filament               | 1.75 mm, 1 kg, single lot                | [TBD]                | [TBD] | [3]   | 70           | 210     |
| ABS filament (optional)    | 1.75 mm, 1 kg                            | [TBD]                | [TBD] | [1]   | 50           | 50      |
| Machine shop and annealing | CNC mill or router, lathe, and oven time | ECB Lab or Wendt Lab | N/A   | 1     | \$0          | \$0     |
| Miscellaneous              | -                                        | [TBD]                | N/A   | [TBD] | \$300        | \$300   |
|                            |                                          |                      |       |       | <b>Total</b> | 1406.71 |

## Goals

### *Major Team Goals for the Next Week (10/23-10/28)*

1. Individually complete and record training certificates onto LabArchives.
2. Fabricate phantom (prototype) for next week's show-and-tell.

### *Next Week's Individual Goals (10/23-10/28)*

- Pierson Trapskin: Create plan for body material.
- Ava Hodgson: Create testing plans for 3D inserts, continue to edit preliminary CDA texture inserts, begin printing inserts.
- Presley Stellflue: Begin fabrication and make decisions on sizing and materials. Need to complete training for the course. CAD anything that needs to be printed.
- Matthew Casas: Help develop testing procedures for evaluating radiomic feature consistency and assist with fabrication of the phantom prototype for the upcoming show-and-tell.
- Sonja Pionek: Help make more CAD models/finalize CAD models for textured inserts to be 3D printed. Compile important info about our project into a short writeup/bullet points for show-and-tell next week.
- Allie Ma: Complete training. Develop slides for next week's show-and-tell.

**PDS:** Completed first draft.

## Timeline

[illegible]

|         |   |   |   |   |   |   |   |   |  |  |  |  |  |  |  |  |
|---------|---|---|---|---|---|---|---|---|--|--|--|--|--|--|--|--|
| Client  |   |   | X | X |   |   | X | X |  |  |  |  |  |  |  |  |
| Advisor | X | X |   | X | X | X | X | X |  |  |  |  |  |  |  |  |
| Website |   |   |   |   |   |   |   |   |  |  |  |  |  |  |  |  |
| Update  | X | X | X | X | X |   |   |   |  |  |  |  |  |  |  |  |

Filled boxes = projected timeline

X = task was worked on or completed

## Detailed accomplishments

### *Previous week's goals and accomplishments by individual*

**Pierson Trapskin:** Completed individual research on alternative methods to create the phantom body if our budget prevents us from using acrylic. I also created SolidWorks models of various different texture inserts.

**Ava Hodgson:** This week, I completed individual research on how to best 3D print medical imaging phantoms to ensure we have the best form to 3D print texture inserts. I create 4 preliminary CAD design for cylindrical texture inserts.

**Presley Stellflue:** This week I completed individual research regarding fabrication plans. I picked up a piece of acrylic for fabrication of the phantom. I have asked questions to more experienced individuals regarding fabrication of the phantom.

**Sonja Pionek:** This week, I read over the requirements for show-and-tell to get an idea of what we need to prepare during our meeting on Friday. I also began working on the trainings required for BME 200.

**Matthew Casas:** This week, I completed individual research on CT radiomics reproducibility and tissue-like texture designs. I investigated how imaging settings affect radiomic measurements and how 3D-printed materials can replicate human tissue textures. This research will help guide our phantom's design and testing procedures.

**Allie Ma:** Began CNC training. Conducted literature research on previous texture studies on CT phantoms.

## Activities

| Name                | Date                | Activity                                                                                                                                  | Time<br>(h) | Week<br>Total<br>(h) | Sem.<br>Total<br>(h) |
|---------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------|----------------------|
| Pierson<br>Trapskin | 9/14<br>and<br>9/15 | Individual research on<br>existing designs and<br>materials.                                                                              | 2           | 2                    | 4                    |
| Pierson<br>Trapskin | 9/16                | Notebook update and<br>progress report 2.                                                                                                 | 1           | 3                    | 5                    |
| Presley Stellflue   | 9/16                | Research on possible<br>materials and dimensions.<br>Began drafting PDS                                                                   | 3           | 3                    | 4                    |
| Ava Hodgson         | 9/14-9/<br>16       | Research on competing<br>designs, pre-existing<br>patents, and standards<br>used to create previous<br>competing designs                  | 5           | 5                    | 5                    |
| Ava Hodgson         | 9/17                | Adding to draft of PDS                                                                                                                    | 1           | 6                    | 6                    |
| Matthew Casas       | 9/17                | Added progress report to<br>website. Individual research<br>on existing radiomics<br>phantom designs and<br>potential materials/textures. | 2           | 2                    | 4                    |
| Allie Ma            | 9/11-9/<br>17       | Began filling PDS<br>information. Researched on<br>standards for phantom<br>development.                                                  | 1.5         | 1.5                  | 1.5                  |

|                   |           |                                                                                                                                                                                                          |   |   |     |
|-------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|-----|
| Presley Stellflue | 9/17-23   | Worked on and edited PDS, completed individual research, and created a SolidWorks model for a design idea.                                                                                               | 7 | 7 | 11  |
| Pierson Trapskin  | 9/18      | Developed an appropriate CAD model for both full size and small scale model size of our front-running design.<br><br>Researched appropriate sizing based of competing design and client recommendations. | 6 | 6 | 10  |
| Allie Ma          | 9/18      | Finished editing PDS. Uploaded PDS under "Project Information >> Team Activities >> Design Process". Any further updates to the PDS will be uploaded in that folder too.                                 | 1 | 1 | 2.5 |
| Allie Ma          | 9/18-9/24 | Wrote up design matrix template. Began editing design matrix grades and reasoning. Annotated key literature provided by client.                                                                          | 3 | 4 | 5.5 |
| Ava Hodgson       | 9/21      | Individual research on biological components of CT scans, possible materials and/or texture ideas for phantom                                                                                            | 2 | 2 | 8   |
| Ava Hodgson       | 9/18-9/23 | Developed CAD design as preliminary design idea for presentation, uploaded to design matrix                                                                                                              | 6 | 8 | 14  |

|                   |            |                                                                                                                                                                                |   |   |    |
|-------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|----|
| Matthew Casas     | 9/18-9/24  | Individual research on 3D-printed materials for CT phantoms and the effects of texture patterns on radiomic features. I also added the progress report to the website.         | 2 | 2 | 6  |
| Ava Hodgson       | 9/29-10/01 | Individual research on CT physics, attenuation & the possibility of 3D printing tissue like materials to gain better understanding of the machine the phantom will be used on. | 4 | 4 | 18 |
| Pierson Trapskin  | 9/29       | 3D printed our model making use of the Design and Innovations Lab at Wendt.                                                                                                    | 1 | 1 | 11 |
| Ava Hodgson       | 9/29-9/30  | Created slides and notes for Preliminary Design presentation for the Background and Competing Designs.                                                                         | 2 | 2 | 20 |
| Pierson Trapskin  | 9/30       | Continued research and brainstorming on materials and costs. Specifically on what materials could help eliminate airgaps and grey matter from scans.                           | 3 | 4 | 15 |
| Presley Stellflue | 9/29-10/1  | Worked on preliminary presentation and edited slides. Conducted individual research on fabrication processes of phantoms and gathered information on competing designs.        | 4 | 4 | 15 |

|                   |           |                                                                                                                                                                                                                                                             |   |   |    |
|-------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|----|
| Matthew Casas     | 9/28-10/1 | Completed individual research on CT phantom designs and radiomic texture features. Created slides and prepared for the Preliminary Design Presentation. Uploaded the progress report and preliminary presentation slideshow to Canvas and the team website. | 4 | 4 | 10 |
| Pierson Trapskin  | 10/3-10/6 | For the preliminary report, I researched and wrote the Introduction and Background sections.                                                                                                                                                                | 6 | 6 | 21 |
| Pierson Trapskin  | 10/4-10/5 | I built up a big part of the report's reference list, and researched the team's choice to focus on physical texture and use an acrylic body with PLA inserts.                                                                                               | 3 | 9 | 24 |
| Presley Stellflue | 10/5-10/7 | I wrote the design specifications, client description, design 1, HU, and the preliminary report conclusion. I also made final edits on grammar and to the cost table. conducted additional and topic-specific research to cite in the report.               | 7 | 7 | 23 |

|                  |             |                                                                                                                                                                                                                                                         |   |   |    |
|------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|----|
| Matthew Casas    | 10/7        | Conducted individual research on CT phantom materials, tissue-equivalent properties, and alternative fabrication methods. Reviewed studies involving PLA, plaster, castable materials, and iodine-ink printing. Updated project research documentation. | 3 | 3 | 13 |
| Pierson Trapskin | 10/12       | Conducted research regarding infill percentage and how the CBCT will read the data.                                                                                                                                                                     | 2 | 2 | 26 |
| Ava Hodgson      | 10/08-10/13 | Individual research on what textures, densities, etc affect the features extracted from CT scans, what ones produce the best results, etc                                                                                                               | 4 | 4 | 24 |
| Ava Hodgson      | 10/13-10/15 | Rough AutoCAD designs for textural inserts                                                                                                                                                                                                              | 4 | 8 | 28 |
| Matthew Casas    | 10/13-10/15 | Conducted individual research on CT phantom materials, texture patterns, and fabrication methods to help evaluate potential designs for our phantom.                                                                                                    | 2 | 2 | 15 |
| Ava Hodgson      | 10/19-10/21 | Individual research for how to 3D print phantoms for medical imaging (compatibility)                                                                                                                                                                    | 2 | 2 | 30 |
| Ava Hodgson      | 10/18-10/22 | Created preliminary texture inserts for phantom in OnShape AutoCAD                                                                                                                                                                                      | 6 | 8 | 36 |

|                   |                 |                                                                                                                                                                                 |   |   |    |
|-------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|----|
| Presley Stellflue | 10/21           | Completed research, planning fabrication                                                                                                                                        | 2 | 2 | 25 |
| Pierson Trapskin  | 10/18 and 10/20 | Created texture models in SolidWorks                                                                                                                                            | 3 | 3 | 29 |
| Matthew Casas     | 10/22           | Conducted individual research on CT radiomics reproducibility, imaging parameters, and 3D-printed liver phantom designs to help guide texture selection and testing procedures. | 2 | 2 | 17 |