

# CT QUALITY ASSURANCE AUTOMATED REPORT BUILDER



BME 402

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**BSAC:** Sam Brenny



# OVERVIEW

- Client Information
- Project Scope
- Recap Progress
- Current Design
- Semester Goals:
  - Improvements
  - Testing
  - Journal Publication
- Acknowledgements & References



# CLIENT INFORMATION

## Dr. Tim Szczykutowicz

- Assistant Professor
  - UW School of Medicine, Radiology, Medical Physics, Biomedical Engineering
- Masters & PhD in medical physics
- Research activities include:  
Optimizing CT scan protocols, patient dose monitoring, and developing protocol management methodologies [1]



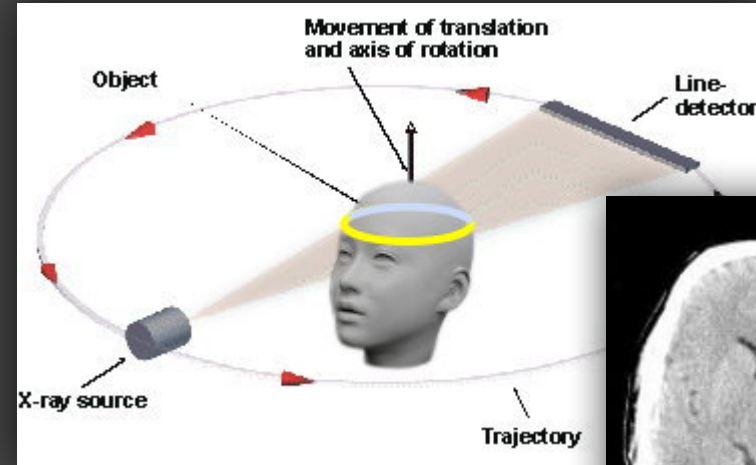
<https://www.radiology.wisc.edu/people/facultyContent.php?vaultID=552>



# BACKGROUND

## Computed Tomography (CT)

- Rotating X-ray
- Cross-sectional images (slices) are created from signals [2]

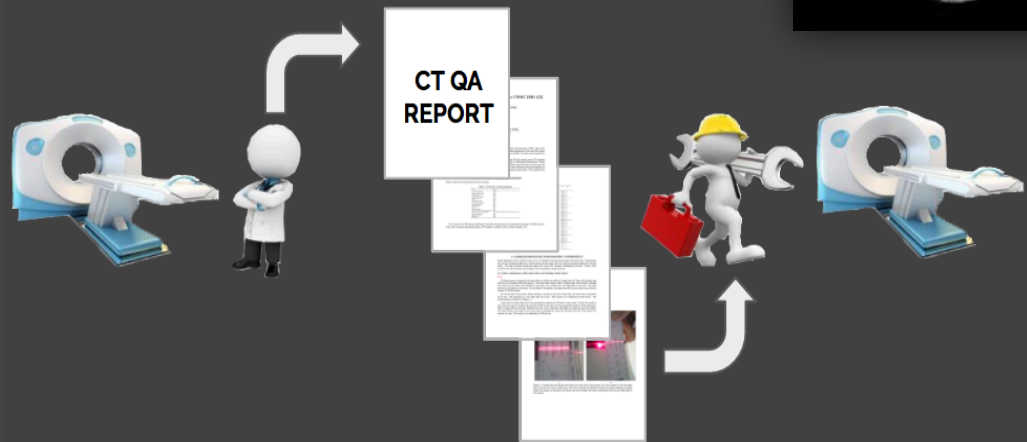


<http://doctorspiller.com/radiation-course-page-19-ct-scans/>



## Quality Assurance (QA) Testing

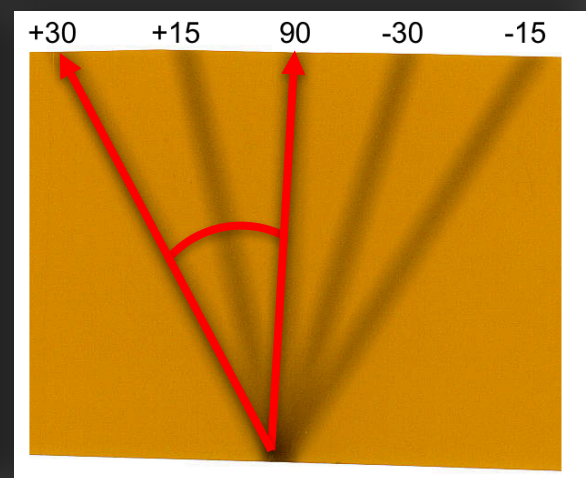
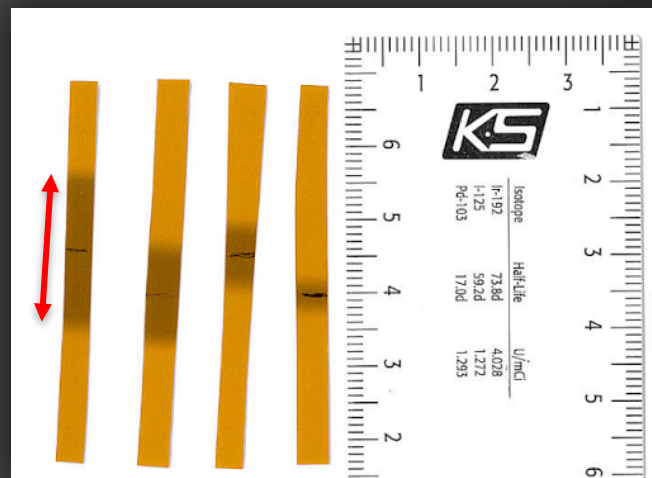
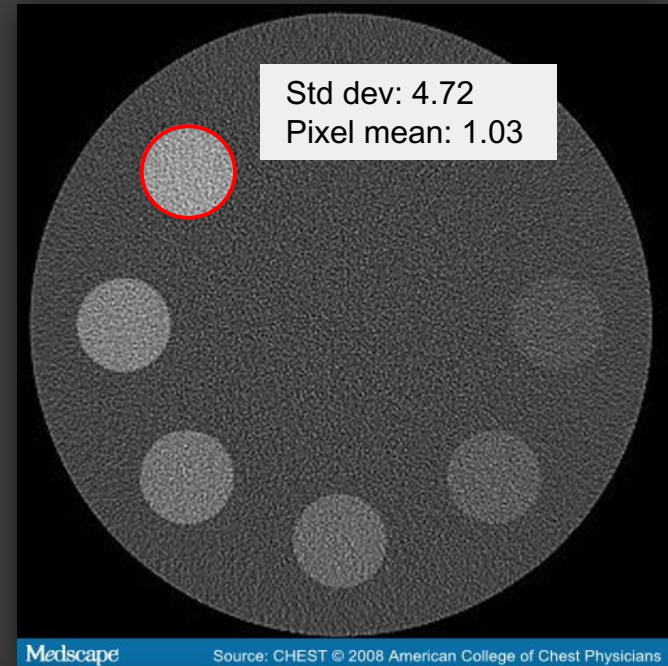
- Ensures scanner is properly calibrated
- Different functions are tested daily, monthly, yearly basis
- Reports generated from testing, sent to technicians for repair [3]



# PROBLEM STATEMENT

An automated software program to assist with CT QA testing will ...

- Standardize reporting
- Automate calculations
- Increase test reproducibility
- Improve communication
- Expedite maintenance
- Reduce errors



# RECAP OF BME 400

## Design Specifications:

### Performance:

- Process CT images
- Create PDF reports using LaTeX

### Accuracy:

- No crashes/bugs
- Pop-up windows to verify calculations

### Ergonomics:

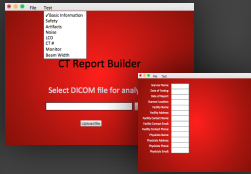

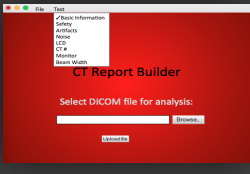
- Intuitive user-interface
- Program Format:
  - Well-commented
  - Modular

### Universal Distribution:

- Packaged into executable

### Standards:

- Outline testing procedures

Design	Design 1		Design 2		Design 3	
						
Criteria (Weight)	Multi-GUI		Text Document		Master GUI	
Ease of Use (30)	4/5	24	3/5	18	5/5	30
Degree of User Interaction (25)	5/5	25	0/5	0	5/5	25
Modularity (20)	2/5	8	0/5	0	4/5	15
Speed (15)	3/5	9	0/5	0	5/5	15
Safety (5)	5/5	5	5/5	5	5/5	5
Cost (5)	5/5	5	5/5	5	5/5	5
<b>Total (100)</b>		<b>76</b>		<b>28</b>		<b>95</b>



# CURRENT DESIGN



# PROGRAM FEATURES

## Functionality

- Automatic CT image analysis
- QA report generated with push of button
- Performs calculations from user input
- Replaces ImageJ & ROI software
- Ability to export a LaTeX compatible text file to create properly formatted PDF

## Algorithms

- Pixel to distance (mm) calculation
- ROI evaluation
- Image angle calculation
- ROI - isocenter distance calculation





# SEMESTER GOALS

- Software improvements
- Develop user manual & video tutorials
- Test program with multiple groups
  - Evaluate testing results
  - Improve program flow & functionality
- Abstract for American Association of Physicists in Medicine (AAPM) symposium
- Journal publication for Journal of Applied Medical Clinical Physics
- Program packaging & distribution



# IMPROVEMENTS

- Create user manual
- Fix all software bugs
- Improve software-user interaction
  - Intuitive
  - Instructions and prompts
- Improve modularity to make editing easier
  - Open source application



# TESTING

## Participants

Classmates in medical imaging class

- Test user interaction

Medical physics dept. at the WIMR

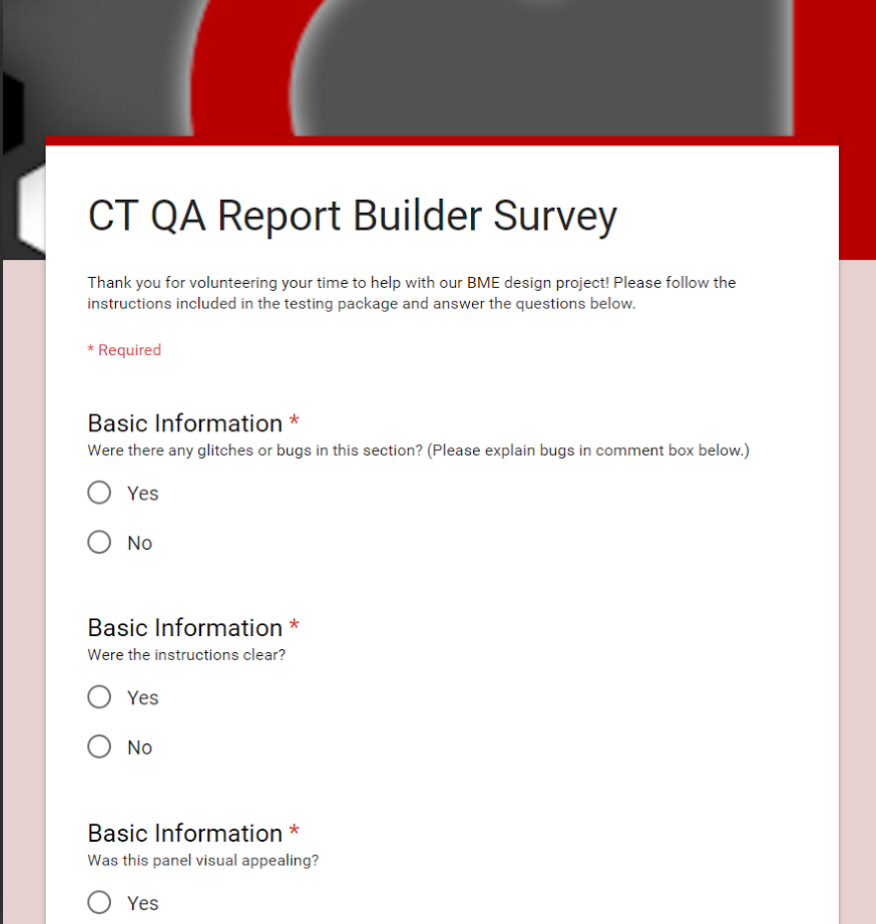
- Test functionality

## Testing Protocol

- Testing package with sample data
- Run program, answer questions

## Survey & Results

- Google forms



The image shows a screenshot of a Google Form titled "CT QA Report Builder Survey". The form is set against a white background with a red header bar. The text of the form is as follows:

**CT QA Report Builder Survey**

Thank you for volunteering your time to help with our BME design project! Please follow the instructions included in the testing package and answer the questions below.

**\* Required**

**Basic Information \***  
Were there any glitches or bugs in this section? (Please explain bugs in comment box below.)

Yes

No

**Basic Information \***  
Were the instructions clear?

Yes

No

**Basic Information \***  
Was this panel visual appealing?

Yes

In the bottom right corner of the slide, there is a vertical stack of three hexagons: a white one at the top, a red one in the middle, and a black one at the bottom.

# ABSTRACT SUBMISSION

AAPM: The American Association of Physicists in Medicine

- Abstract Submission & Supporting Document → Mar 9<sup>th</sup>
- Annual Meeting → July 30<sup>th</sup> - Aug 3<sup>rd</sup> in Boulder, CO
  - Poster or Oral Presentation



<http://www.aapm.org/meetings/2017AM/>



# JOURNAL PUBLICATION

## JACMP: Journal of Applied Clinical Medical Physics

- Open-access journal
- Affiliated with AAMP



<https://pkpservices.sfu.ca/content/journal-applied-clinical-medical-physics>

OR

## Medical Physics

- Requires subscription
- Affiliated with AAMP



<http://medphys.org/>



# FUTURE WORK

- Submit abstract
- Perform testing
- Implement changes
- Update user manual
- Write journal article
- Distribute final software package



# ACKNOWLEDGEMENTS

We would like to thank:

- Client: Prof. Tim Szczykutowicz, Dept. of Radiology
- Advisor: Prof. John Webster, Dept. of Biomedical Engineering
- Department: UW Biomedical Engineering



# REFERENCES

- [1] "Faculty and Staff," University of Wisconsin School of Medicine and Public Health. [Online]. Available: <https://www.radiology.wisc.edu/people/facultyContent.php?vaultID=552>
- [2] "CT Scan," Mayo Clinic [Online]. Available: <http://www.mayoclinic.org/tests-procedures/ct-scan/basics/definition/prc-20014610>
- [3] T.P. Szczykutowicz. "CT Scanner Annual Testing: East Clinic UWHC DHO," UW-Madison Dept. of Radiology. Madison, WI. July, 2016.





QUESTIONS?

