Automated Quality Assurance System for Clinical CT Systems

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Abstract
Purpose: To create an open source software program capable of assisting a user in capturing the needed components of a computed tomography (CT) quality assurance (QA) report. The report is generated in a manner that expedites physician to technician communication in cases where problems with the scanner are discovered.

Methods: The software program was created using MATLAB®’s graphical user interface platform. The graphical user interface (GUI) has fifteen panels, each facilitating a QA testing protocol by either collecting simple pass/fail or yes/no information, capturing physicist comments and measured values, and analyzing imported images. The GUI produces a LaTeX-formatted test file after the results are calculated which is compiled into a PDF final report. The program is designed to be open source and will accept new users adding new panels to enable customization for different tests.

Results: A graphical user interface was developed to assist in capturing CT report data, analyzing CT QA test results and generating a formatted report that details the testing protocols and results of the QA tests. The program is capable of analyzing images for artifacts, noise, CT number, CT uniformity, gantry tilt, beamwidth, slice widths, and low contrast detectability (LCCD), and accepting user input after testing the safety protocols, dose, protocol review, and the monitor. The resulting data from the analyses is organized and exported into a LaTeX-formatted test file which is used to create the report. Images of how laser alignment and couch travel are included in the report to aid conveying issues to technicians.

Conclusion: The CT QA report-building software combines all the necessary tools for QA testing into a single program, automating calculations, and generating formatted reports with the results and testing procedures. This program aims to improve communication between the medical physicist and service engineer by generating consistently-formatted reports and explaining the testing procedures to improve the reproducibility of each test.

Motivation
- No standardized protocols for computed tomography (CT) quality assurance (QA) → inconsistency and miscommunication
- Miscommunication can delay CT system adjustments
- CT quality assurance testing and reporting takes hours
- Measurements taken & computed by hand = room for error

Background
CT Quality Assurance
- Tests to assess machine functionality
  - Performed regularly on daily/weekly/monthly/yearly basis [1]
  - Multiple tests to assess certain machine functionalities [2]
  - Image phantoms are used to evaluate CT machines [3]

Software Features
Software features & capabilities:
- Automatic CT image analysis
- QA report generated with push of button
- Performs calculations from user input
- Combines tools from several external programs into one
- Ability to export a LaTeX compatible test file to create properly formatted PDF

Final Design
Final Report
- The “Export” button generates LaTeX formatted report

Testing & Results
Testing
- Tested by:
  - Students in medical imaging class
  - Medical physicists & residents of the Wisconsin Institutes for Medical Research
- Survey-based feedback evaluated design, intuitiveness, and possible bugs
- Feedback used to improve user interaction & improve ease of use

Results & Significance
- Program streamlines communication between medical physicists and service engineers
- Reduces time and labor of CT QA testing

Future Work
- Continued extensive testing of user interaction with program
- Modifications & improvements based on tester feedback
- Incorporate additional QA tests & functionality upon client request
- Package & distribute as an open-source program or standalone application

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References