# Automated quality assurance system for clinical CT systems

Design Excellence Executive Summary

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Quality assurance (QA) for computed tomography (CT) systems requires extensive testing to produce high-resolution medical images while minimizing the patient's radiation exposure. The testing is performed by a medical physicist who compiles the data into a comprehensive report used by the manufacturer's service technician. The technicians rely on the results and testing protocols to properly adjust the machines. Currently, unstructured reports lead to communication issues between the physicist and technicians, reducing the machine's availability for critical diagnostic and radiation therapy procedures. Therefore, our client Dr. Szczykutowicz requested a program to automate QA testing and reporting to expedite and standardize the entire CT QA process.

Several expensive software programs for analyzing CT systems for QA exist, but are limited in their testing functionality and lack customization. Additionally, the reports are formatted for the medical physicist's uses instead of the service technician's. In order to customize testing and redesign the reports with the service technician in mind, a graphical user interface (GUI) was created with MATLAB's guide platform. This way, new functionality can be incorporated by simply adding a new panel to the existing program.

The software program consists of a single GUI featuring a panel for each QA test. Both the program and report supplement data collection with protocols to improve the reproducibility of each test by different medical physicists and service technicians. The program currently has fifteen panels and is capable of supporting more. Some of the panels analyze CT images to evaluate artifacts, noise, and CT number, while other panels serve to expedite manual calculations. For example, the program loads images of radiochromic film obtained from a CT scan to calculate both beam width and gantry tilt instead of the physicist measuring the film by hand. Other panels evaluate discrepancies in the computer monitor screen luminance, the positioning of the couch (the CT table), and laser alignment. These tests require physical data acquisition and entry, but all of the associated calculations are automated. Finally, the "Export" button will automatically generate a report of the data processed by the GUI. The data is organized and exported to a text file so LaTeX can generate the properly formatted CT QA report. All of these panels reduce the need to use external imaging software such as ImageJ or other CT image analysis programs. Most importantly, it compiles all necessary software into a single executable package that will be available to all medical physicists.

Through many meetings with the client, each testing panel was discussed, designed, and then reevaluated to increase the functionality of the software. In the meetings, it was determined that both medical imaging students and professionals could provide useful feedback for design validation. Therefore, the BME 530 Medical Imaging class at UW-Madison served as a useful focus group, providing feedback on aesthetics and overall intuitiveness of the interface. Additionally, Dr. Szczykutowicz distributed the software to colleagues for feedback on specific testing protocols and their functionality.