

## Background

Just what is the composition of imaging data sitting in your PACS? How much of a burden are those "external studies" your patients have been bringing as prior exams? What alternatives are there to storing "some-body-else's" data in your PACS? We set out to answer these questions for our institution.

## Evaluation

We developed, in house, an open-source software tool, named, "PACSCrawler" based on open-source library DCM4CHE (dcm4che.org), to extract the contents of our PACS to a local SQLite database (sqlite.org) for analysis using database tools. The PACSCrawler retrieved key DICOM header information for each study stored in our PACS for the last 6 years. The DICOM tag "Institution Name" (0008,0080) was used to stratify data into internal versus external studies. The category internal studies was further subdivided into three different sites: main, geriatrics and pediatric hospitals. About 1,000,000 studies were identified from 2010-15, which required <1GB SQLite local storage; processing time was <1hr. The average percentage of external studies in PACS storage was 12% ranging from 9-15% depending on the year (12,781-22,747 studies). The number of external studies was comparable to that of our pediatric radiology division. In other words, external institution's data was as much of a burden on our system as one of our own divisions. While these external exams were arriving from over 300 different entities, 90% came from 12 local private practices and hospitals.

## Discussion

While digital storage space is relatively cheap, avoiding unintended data redundancies can be one approach to cope with the ever exploding quantity of imaging studies being performed in medicine. The presented open source software allows for fast storage analysis independent of the PACS vendor. The software may help to form a regional PACS initiative by identifying potential partners, among those who contribute the majority of outside studies.

### SSM12-03 Diagnostic Performance in Detecting Cerebral Infarction on Brain CT: Comparison of Liquid Crystal Displays with Different Resolutions and Luminance

Wednesday, Nov. 30 3:20PM - 3:30PM Room: S403A

#### Participants

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#### PURPOSE

It is well known that high quality image display is associated with a more efficient and accurate diagnostic performance. Among the several factors that influence image quality, spatial resolution and luminance play a critical role. In the present study we evaluated the impact of these parameters in identifying cerebral infarction on brain CT.

#### METHOD AND MATERIALS

Four color Nec medical displays with different spatial resolution, 2 and 3-megapixel (MP) and maximum luminance, 200 and 400 cd/m<sup>2</sup>, were investigated with proper ambient lighting conditions. Thirty-two studies varying in difficulty of interpretation were selected by a senior radiologist: 16 with and 16 without brain infarction. All the images were blindly and independently evaluated, during two different sessions, by the senior radiologist and by two junior radiologists. Observers had to rate presence or absence of cerebral infarction on a five point confidence scale. The Cohen Kappa statistic (Kc) was computed in order to evaluate the reproducibility in identifying the presence of the lesions between monitors and within/between radiologists; receiver operation characteristic (ROC) analysis was used to interpret the data and the area under ROC curves (AUC) was considered as the index of diagnostic accuracy.

#### RESULTS

Preliminary results showed that the senior radiologist evaluations produced a satisfactory level of reproducibility between differently set displays. The observed level of reproducibility decreased for the junior radiologist with the 2 MP display when lowest luminance was set. The AUCs increased with the rise of display's spatial resolution and luminance for both the observers; the differences of observer performance between 3MP display with the highest luminance and 2MP display with the lowest luminance were statistically significant ( $p < 0.05$ ) for the junior radiologists in both reading sessions.

#### CONCLUSION

Our study suggests that both high luminance and spatial resolution play a very important role in identifying cerebral infarction on brain CT.

#### CLINICAL RELEVANCE/APPLICATION

3MP liquid crystal displays with maximum luminance 400 cd/m<sup>2</sup> show the best accuracy in the diagnosis of cerebral infarction on brain CT.

### SSM12-04 Collaborative Robotic Ultrasound: Towards Clinical Application

Wednesday, Nov. 30 3:30PM - 3:40PM Room: S403A

#### Participants

Benjamin Frisch, PhD, Munich, Germany (*Presenter*) Nothing to Disclose  
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## CONCLUSION

Collaborative medical robotics pave the way for advanced and complex diagnostic US and US-guided interventions whose value will be proven by patient trials.

## Background

Ultrasound (US) is a compact, widely available and customizable non-radiative imaging modality. However, the image quality and its interpretation depend on the user's abilities, leading to high interobserver variation. The acquisition of 3D datasets is limited to a comparatively narrow field of view. We introduce an US transducer mounted on a light-weight robotic arm that collaborates with the operator for 3D high-quality image acquisition and interventional support. The arm is equipped with torque sensors in all joints to ensure constant contact force of the transducer onto the skin and to detect collisions with the environment. External structured light cameras (SLCs) monitor the position of the patient, operators and tools to plan or dynamically replan the arm's trajectory. The inclusion of confidence maps allows for a real-time automatic optimization of the US image quality.

## Evaluation

The first demonstrator, for vascular imaging, recognizes the patient's position with the SLCs to register an anatomical atlas, and automatically guides the US transducer to the aorta. Confidence maps optimize the acquisition of 3D US images, which allowed successful aortic diameter measurements on healthy volunteers. A second demonstrator evaluates a neurosurgical application, where the spine is monitored for targeted needle insertion. We acquire 3D images of the region of interest on a spine model embedded in a dedicated gelatin-agar phantom. A needle guide is rigidly mounted to the US transducer to allow automatic alignment of the needle to a preinterventional target trajectory defined in a registered CT volume. After insertion, correct placement in the facet joint could be validated using cone-beam CT in four phantom experiments.

## Discussion

Both demonstrators confirm the feasibility of robotic US. The combination of situational awareness through sensors and external cameras, and real-time image optimization creates a system that supports an operator for imaging and intervention.

## SSM12-05 Semi-Automated Analysis of Urinary Stones Using Dual-Energy CT in a Preoperative Setting: Improved Workflow and Reporting

Wednesday, Nov. 30 3:40PM - 3:50PM Room: S403A

### Participants

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Cynthia H. McCollough, PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, Siemens AG

## CONCLUSION

Results suggest that the information provided by the software could have a significant impact in the evaluation of kidney stones in a preoperative setting.

## Background

The purpose of this work was to demonstrate and test an in-house developed tool for semi-automated analysis of urinary stones in dual-energy CT (DECT).

## Evaluation

Fifty-eight patients that underwent unenhanced DECT prior to surgical stone removal between October 2009 and November 2015 were subject to stone analysis. Patients were scanned according to our clinical protocol for urinary stone characterization using a dual-source CT system (Somatom Flash and Somatom Force, Siemens Healthcare). In the first step of the imaging analysis, 5-mm thick combined (low/high kV) images were loaded in to the workstation and a research technologist segmented the operated kidney using a set of ROI drawing tools. Subsequently, a radiologist expert in genitourinary imaging loaded 1-mm thick, low and high energy images with the interpolated 5-mm kidney ROI. Using a ROI analysis tool, the reader specified the kidney of interest and stones were automatically segmented and analyzed using an adaptive threshold method. After the completion of the analysis, reports were loaded in a stone browser and the reader specified the stone location using an 11-segment model. For qualitative analysis, reader compared diagnostic images (1 mm axial and 2mm coronal) and clinical reports with the information provided by the software and recorded per-patient and per-stone positive or adverse findings that would modified the clinical report.

## Discussion

There were 349 stones detected and analyzed by the software. Qualitative per-patient analysis indicated positive findings for two patients where two stones were detected by the software and not noted by the reader in the clinical images. There was an adverse impact in the report of 8 patients where 12 small stones (~ 1-2 mm) were not detected. Per-stone analysis indicated positive impact for the clinical report in 17 stones with common reasons being improved separation of adjacent stones and size characterization of complex large stones. Three calcifications external to the kidney were misclassified as urinary stones.

## Honored Educators

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Terri J. Vrtiska, MD - 2016 Honored Educator

## SSM12-06 Influence of Medical Displays with Different Spatial Resolution and Luminance on the Evaluation of