SU-FF-I-23
Comparison of Amplitude-Based and Phased-Based Binning Techniques for Respiratory Correlated CT
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Purpose: To evaluate amplitude-based and phase-based approaches for generating respiratory correlated CT (RCCT) images in terms of spatial coherence and residual motion artifacts. Method and Materials: A programmable robot arm (Kawasaki, FS-2, KRL, Wixom, MI) with an attached phantom consisting of 3 – 6 cm. diameter spheres was used to simulate various breathing patterns. Both the Varian RPM system and a bellows device were used as surrogates for monitoring. The robot arm was commanded to perform asymmetric “exhale/inhale” sequences with a variable cycle time, and it allowed for multi-axis trajectories, hysteresis and pseudo-random motion. The effectiveness of amplitude-based and phase-based binning algorithms on the resultant images of a spherical phantom was quantified by calculating the average deviation from a spherical surface. Both binning methods were applied to patient data sets and qualitatively evaluated. Results: Amplitude-based binning produces fewer artifacts, especially when the breathing frequency was varied during the acquisition. When using phase-based techniques the measured radii of spherical object had twice the variance as compared to amplitude-based algorithms. Conclusion: Amplitude-based binning has merit in generating RCCT image volumes. Preliminary results suggest that they generate fewer artifacts and are more accurately correlated to the internal organ motion, especially when the breathing frequency varied during the acquisition. More investigation is warranted to evaluate the impact of this new methodology on treatment planning and delivery. Conflict of Interest: The author is an employee of Philips Medical Systems

SU-FF-I-24
Evaluation of Time Sampling and Its Interpolation Effect Based On Deconvolution Technique for Quantification of Cerebral Perfusion by Dynamic Contrast Enhanced CT
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Purpose: To investigate time sampling and its interpolation effect on cerebral perfusion measurements from the possibility of lower radiation-dose CT examination than usual. Method and Materials: Immediately after non-enhanced transverse scanning of a patient’s brain, contrast material-enhanced scanning was performed every 1 second for 40 seconds at a single-slice level. Uniform time sampling was executed from 1/2 to 1/7 rate of total time series, respectively. Thirty tissue concentration time-course data were collected, and arterial input curve data were fitted by gamma-variate function. The sinc function was introduced for interpolation. Deconvolution analysis based on singular value decomposition was performed for quantification of CBF. The lowest singular value corresponding to the minimum difference between residue and its exponential curve-fitted function was considered as the optimal threshold value. The CBF values were calculated from the maximum of the scaled residue function. The perfusion values through time sampling and interpolation were compared with the original perfusion values by independent samples t-test. Results: The CBF values without interpolation were underestimated with a decrease of sampling rate, and with interpolation had a tendency fluctuated around the original CBF values. The CBV values through time sampling were not statistically different from the original CBV values regardless of the existence of interpolation. The MTT values without interpolation were overestimated with a decrease of sampling rate, and with interpolation had a tendency fluctuated inversely to CBF change around the original MTT. Time sampling without interpolation was statistically possible up to 1/2 sampling rate, and with interpolation up to 1/5 sampling rate. Conclusion: The perfusion values through time sampling with interpolation are acceptable up to some less sampling rate, and more accurate than without interpolation. This study will help in selecting reasonable image acquisition time interval for low-radiation-dose CT examination. Conflict of Interest: Young Investigator Competition

SU-FF-I-25
Optimizing Dose and Image Quality in Pediatric Computed Tomography
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Purpose: The goal of this work was to accurately quantify the doses delivered to pediatric patients during computed tomography (CT) exams while simultaneously evaluating the image quality of images obtained with the same protocols, and thus identify potential dose-saving protocols that maintain adequate image quality. Method and Materials: A tomographic newborn physical phantom was constructed from tissue-equivalent materials for use in evaluating the doses delivered to pediatric patients as a result of diagnostic imaging. Fiber optic-coupled (FOC) dosimeters were used along with the physical phantom to measure average organ doses during CT exams across a wide range of protocol parameters (80-120 kV, 50-150 mAs, 12 mm and 24 mm collimated beam widths, pitches of 0.75, 1.0, and 1.25, for both head and body protocols). Then, images of the Catphan CTP515 low contrast module were acquired using the same protocols, and scored automatically with a custom-written scoring routine with threshold contrast-to-noise ratios (CNR) based on radiologists’ scoring of similar phantom images. Results: Measured effective dose values for head exams ranged from 0.33 mSv to 4.3 mSv, depending on protocol selection. These effective dose values are driven by doses to the bone marrow, bone surface, brain, and thyroid gland. Measured effective doses for CAP exams ranged from 1 mSv to 14.3 mSv, depending on protocol selection. A collimated beam width of 24 mm (16 x 1.5) was determined to be the optimal setting for both head and CAP imaging in terms of both image quality and dose. Conclusions: Tube potential and tube current-time product are the two major contributors to both dose and image quality. However, the use of pitch values less than 1.0 does not involve a substantial dose penalty (approximately 30 percent greater dose) without providing any significant gains in image quality for general imaging tasks.

SU-FF-I-26
Tissue Equivalent Phantoms for the Evaluation of Tube Current Modulated CT Dose and Image Quality
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Purpose: To develop and test new, flexible, tissue-equivalent phantoms for the evaluation of tube current modulation dose reduction and image quality for CT. The developed phantom material also has applications for mammographic and 4-D time varying phantoms. Method and Materials: A compressible, flexible, urethane-based tissue equivalent phantom material was developed and utilized in the production of elliptoid shaped phantoms for CT imaging. Multiple phantoms were created, each with different major (26-40 cm) and minor (18-28 cm) axes, in order to model patients of varying dimensions and thicknesses. All phantoms were made to be integrated with a Catphan CT image quality phantom as well as CTDI dose assessment phantoms. Image evaluation software was utilized in order to evaluate several image quality parameters in CT images taken using the phantoms in order to quantify the effects of tube current modulation in CT scanners for varying techniques. Ion chamber and gated fiber optically coupled dosimeters were also used with the phantoms in order to evaluate the effects of tube current modulation on dose to patients of varying dimensions. Results: It was found that the use of ellipsoid shaped phantoms allowed for more accurate observation of dose and image quality effects of tube current modulation in CT scanners over traditional circular acrylic phantoms. Patient doses were found the be less for studies in which tube current modulation was in use as compared to standard CT techniques, however the degree of dose reduction was found to be largely influenced by the major and minor axes of the ellipse. Conclusion: This work shows potential of ellipsoid phantoms to aid in dose reduction in CT scanning through tube current modulation by allowing more accurate modeling of actual patient dimensions.

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