Multi-Energy CT Phantom Clinical Studies

Intermanufacturer Comparison of Dual-Energy CT Iodine Quantification and Monochromatic Attenuation: A Phantom Study

M. C. Jacobsen, et al., The University of Texas MD Anderson Cancer Center, Houston, TX, U.S., Radiology 2018 Apr; 287(1):224-234. doi: 10.1148/radiol.2017170896

- *“Materials and Methods: A large elliptical phantom containing iodine (2, 5, and 15 mg/mL), simulated contrast material-enhanced blood, and soft-tissue inserts with known elemental compositions was scanned three to five times with seven dual-energy CT systems and a total of 10 kilovolt peak settings.”*
- *“A dual-energy quality control phantom was developed in collaboration with Gammex (Sun Nuclear, Middleton, Wis). The elliptical, epoxy resin–based phantom with soft-tissue background to mimic clinical scatter conditions measures 40 cm × 30 cm × 15 cm (Fig 1) and contains multiple material inserts designed for evaluation of dual-energy CT systems, such as soft tissue, iodine (2, 5, and 15 mg/mL), and simulated contrast material–enhanced blood.”*
- *“The strengths of this study included the use of a single physical phantom, designed specifically for this application, which was used with all scanners examined.”*

Figure 1

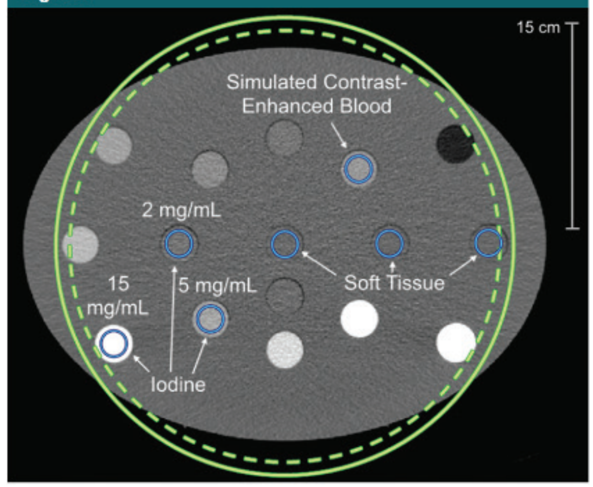
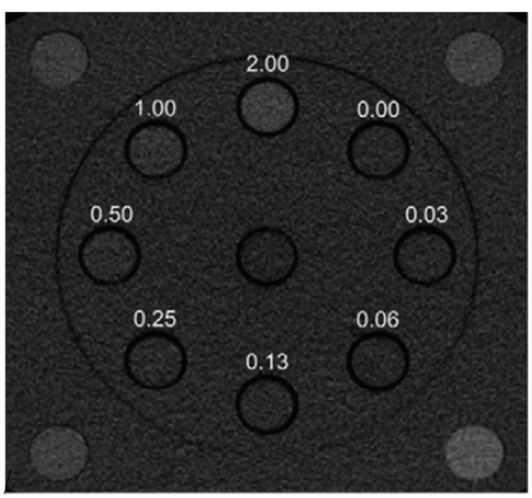


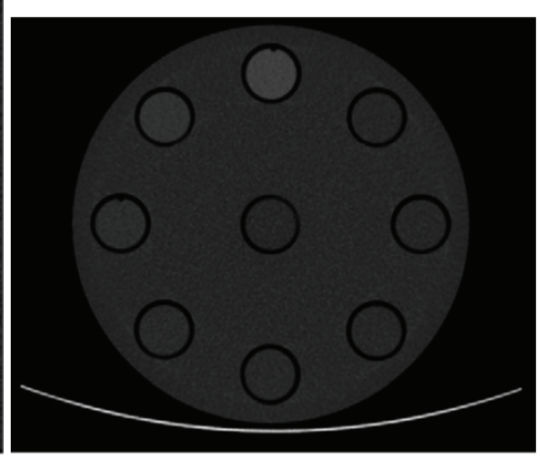
Figure 1. A 120-kVp image shows dual-energy quality-control phantom prototype containing clinically relevant, spectrally equivalent material inserts. Phantom measures 30 cm x 40 cm on axial plane and extends 15 cm along z-axis. Locations of iodine inserts (2, 5, and 15 mg of iodine per milliliter), the three soft tissue inserts, and the simulated contrast-enhanced blood insert used for the analysis are shown. Dotted green circle represents dual-energy field of view for the Siemens Flash (DS1, 33 cm), while solid green circle represents dual-energy field of view for Siemens Force (DS2, 35 cm). All other scanners had a field of view of 50 cm.

Dual-Energy CT: Lower Limits of Iodine Detection and Quantification

M. C. Jacobsen, et al., The University of Texas MD Anderson Cancer Center, Houston, TX, U.S., Radiology 2019 Aug; 292(2):414-419. doi: 10.1148/radiol.2019182870

- *“Recent studies used DE CT quantitation of iodine concentration to determine diagnostic thresholds between various disease states.”*
- *“Before one applies DE CT–derived diagnostic thresholds to patient data, it is crucial to understand the limits of iodine quantitation.”*
- *“The iodine limit of detection using dual-energy CT systems varies with scanner and phantom size, but all systems enable detection of iodine at or below 0.3 and 0.5 mg/mL in the small and large phantoms, respectively”*





Accuracy and reproducibility of effective atomic number and electron density measurements from sequential dual energy CT

C. Schaeffer, et al., Department of Radiology, University of Florida, Gainesville, FL, U.S., Med Phys, 2021 Jul; 48(7):3525-3539. doi: 10.1002/mp.14916

- ***"Methods:** The Gammex Multi-Energy CT head and body phantoms were used to measure Zeff and electron density from 35 rod inserts that mimic tissues and varying concentrations of iodine and calcium. Scans were performed on a Canon Aquilion ONE Genesis CT scanner over a period of 6 months using default dual energy protocols appropriate for each phantom size."*

Figure 1. The Gammex Multi-Energy CT phantom with tissue-mimicking rods. The picture shows the "body" configuration; the central section of the phantom can be used separatley as a "head" phantom.

Influence of beam hardening in dual-energy CT imaging: phantom study for iodine mapping, virtual monoenergetic imaging, and virtual non-contrast imaging

R. Kanatani,, et al., Department of Health Sciences, School of Medical Sciences, Kyushu University, Fukuoka, JP, European Radiology Experimental, 2021 Dec; 5: 18. Published online 2021 Apr 27. doi: 10.1186/s41747-021-00217-1

Synthesized effective atomic numbers for commercially available dual-energy CT

D. Kawahara, et al., Department of Radiation Oncology, Institute of Biomedical & Health Sciences, Hiroshima University, JP, Rep Pract Oncol Radiother. Jul-Aug 2020; 25(4):692-697. doi: 10.1016/j.rpor.2020.02.007.

A novel fast kilovoltage switching dual-energy CT with deep learning: Accuracy of CT number on virtual monochromatic imaging and iodine quantification

T. Kojima, et al., Division of Radiology, Department of Medical Technology, Kyushu University Hospital, Fukuoka, JP, Phys Med 2021 Jan; 81:253-261. doi: 10.1016/j.ejmp.2020.12.018.

Accuracy of Quantification of Iodine and Hounsfield Unit Values on Virtual Monochromatic Imaging Using Dual-Energy Computed Tomography: Comparison of Dual-Layer Computed Tomography With Fast Kilovolt-Switching Computed Tomography

H. Washio, et al., Department of Radiology, Hyogo Yoka Hospital, Hyogo, JP, J Comput Assist Tomogr. Nov/Dec 2018; 42(6):965-971. doi: 10.1097/RCT.0000000000000798

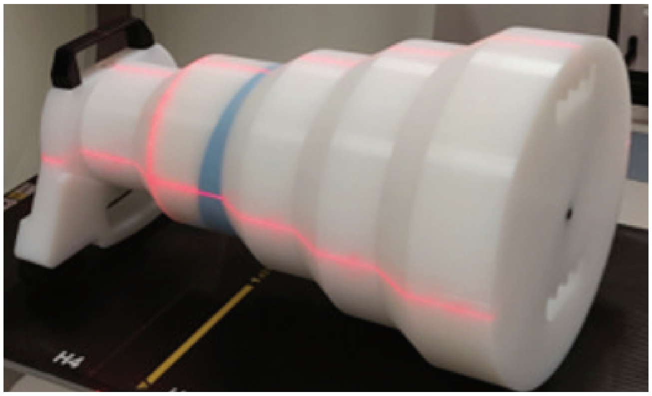
Development of a dual-energy computed tomography quality control program: Characterization of scanner response and definition of relevant parameters for a fast-kVp switching dual-energy computed tomography system

J. Nute, et al., The University of Texas MD Anderson Cancer Center, Houston, TX, U.S., Med Phys. 2018 Apr; 45(4):1444-1458. doi: 10.1002/mp.12812.

Dual-Energy Computed Tomography for the Characterization of Intracranial Hemorrhage and Calcification: A Systematic Approach in a Phantom System

J. Nute, et al., The University of Texas MD Anderson Cancer Center, Houston, TX, U.S., Invest Radiol. 2017 Jan; 52(1):30-41. doi: 10.1097/RLI.0000000000000300.

Mercury 4.0 Phantom Clinical Studies



A methodology for image quality evaluation of advanced CT systems

J. Wilson, et al., Department of Radiology, Duke University Medical Center, Durham, NC, U.S., International Journal of Medical Physics Research and Practice 40 (3), (2013)

- *"Purpose: This work involved the development of a phantom-based method to quantify the performance of tube current modulation and iterative reconstruction in modern computed tomography (CT) systems. The quantification included resolution, HU accuracy, noise, and noise texture accounting for the impact of contrast, prescribed dose, reconstruction algorithm, and body size."*

Characteristic image quality of a third generation dual-source MDCT scanner: Noise, resolution, and detectability

J. Solomon, et al., Department of Radiology, Duke University Medical Center, Durham, NC, U.S., International Journal of Medical Physics Research and Practice 42 (8), (2015)

- *"Results: …Assessing the impact of mA modulation for a fixed average dose over the length of the phantom, detectability was up to 49% lower in smaller phantom sections and up to 26% higher in larger phantom sections for the modulated scan compared to a fixed tube current scan. Overall, the detectability exhibited less variability with phantom size for modulated scans compared to fixed tube current scans."*