iWoRiD 2022
23rd International Workshop on Radiation Imaging Detectors
26 – 30 June 2022
Riva del Garda, Italy

Contribution ID: **6** Type: **Poster**

A Scattered X-ray Correction Method and its Verification by Energy-resolved CT

Monday 27 June 2022 16:28 (1 minute)

In X-ray transmission measurements, scattered X-rays distort X-ray images. Medical doctors will overcome such distortion with their experience in reading images of an X-ray film and a flat panel detector. Computed tomography (CT), however, gives images after processing digital data given by transmission measurements, and sometimes results in wrong images. Hardware and software have been developed for removing the scattered X-rays. A grid is a hardware which absorbs the scattered X-rays, however, it also reduces primary X-rays which are necessary for imaging and brings higher dose exposure to a subject for having a proper image. Simulation calculation [1] and deep learning [2] are software for rejecting the scattered X-rays, but they require long calculation time and huge amount of data.

In this paper, we propose a method for the scattered X-ray correction with a simple experiment and deterministic calculation. The scatter correction methods are described in three stages: scatter correction with (1) a scatter-correction (SC) cylinder phantom which dimensions are the same with a subject under inspection (SUI), (2) SC cylinder phantoms smaller and larger than the SUI, (3) SC cylinder phantoms smaller and larger than the SUI with a deformed shape which is similar to a human body. The SUI is made of acrylic with six kinds of resin rods, which effective atomic numbers are similar to the ones of inner organs.

With CT data without and with SC, energy-resolved analysis was performed to have linear attenuation coefficients of resins. The linear attenuation coefficients without SC showed smaller values than the ones of the National Institute of Standard and Technology (NIST), however, the ones with SC agree with the ones of the NIST excellently as shown in Figure 1 [3].

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[1] T.-H. Tsai, I. Kanno, J. Nucl. Sci. Technol., 54, 205-212 (2016).
[2] S. Xie, C. Yang, Z. Zhang, et al. IEEE Access. 6, 78031-78037 (2018).
[3] M. J. Berger, J. H. Hubbel, S. M. Seltzer, et al. http://nist.gov/pml/xcom-photon-cross-sections-database.

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Session Classification: Poster