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CHARACTERISTICS OF X-RAY BEAM USED IN COMPUTED TOMOGRAPHY

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Patient exposure from Computed Tomography (CT) was simulated using Monte Carlo method. The model of rotating source was implemented previously.

Conversion coefficients from measured dose indexes to doses in organs and tissues of patient were determined. Each coefficient is a quotient of calculated organ dose divided by a weighted calculated computed tomography dose index ($CTDI_w$). Simulation using Monte Carlo method requires the energy spectrum of incident radiation. The anode angle and total beam filtration determine the energy spectrum. When these quantities are unknown, measurements of attenuation in cylinder dosimetric phantom can be used to characterize the spectrum.

A comparison of radiation doses to patients during CT examinations was performed in [1] and showed that the $CTDI_w$ measured in CT scanners from various manufacturers have large discrepancies while input settings are the same. Organ doses differed by a factor of two and the similar image quality. Hence, the scanner-specific doses should be calculated. However, when a conversion coefficients are studied, their variation is much smaller (several percent). This suggests using of a limited set of conversion coefficients, calculated for a number of combinations of filters and anode angles. These values can be matched to calculated coefficients based on $CTDI_W$ measurements.

Energy spectrum can be characterized using the quotient of $CTDI_w$ measured in cylinder dosimetric phantom to $CTDI_{air}$ measured free-in-air. This relation lies in the range of 0.27 to 0.77 for different CT scanners [2]. Based on this relation appropriate set of conversion coefficients can be chosen to estimate organ doses. Current quality assurance protocols requires only phantom measurements of $CTDI_w$. This approach can provide doses to adults only [3].

Apart from the energy spectrum beam profile also impacts the dose. Simulation needs the shape of bow-tie filter that determines the beam profile. The beam profile can be measured using ionization chamber while the X-ray tube position is fixed. Several beam profiles were published [4] and can be used in simulation of specific scanners.

1. A.C.Turner, M.Zankl, J.J.DeMarco, et al. // Med. Phys. 2010. V. 37 (4). P. 1816.
2. G.Bonartz, S.J.Golding, A.G.Jurik, et al. European guidelines on quality criteria for Computed Tomography. EUR 16262 EN. –Brussels: European Commission, 1999. –114 p.
3. P.Shrimpton. Patient Dose Assessment in CT NRPB report PH/1/2004. –Chilton, UK: NRPB, 2004. –42 p.
4. M.Ghita // Computer simulations to estimate organ doses from clinically validated cardiac, neuro, and pediatric protocols for multiple detector computed tomography scanners [Dissertation]. - University of Florida, 2009.

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