SCATTERING CORRECTION IN CONE BEAM COMPUTED TOMOGRAPHY

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Introduction

Quantitative reconstruction values in Cone Beam Computed Tomography (CBCT) are miscalculated due to presence of secondary radiation originating from scattering of photons inside the object under consideration and the imaging detector leading to cupping and streaking artifacts. The effect is prominent in NDT simulations by CEA. The weight kernels parameters A, B, α, β, σ, and σ̇ are interpolated in order to evaluate the advantage of continuous kernels approach.

SKS deconvolution method corrects scatter per projection by convoluting the measured signal with the pencil beam kernels $h_k$ using equation (1), simulated by varying thickness of the slabs of same material as the object in the CIVA ² RT module developed for NDT simulations by CEA. The weight of the kernel is the ratio of scatter at each pixel of the detector to the primary at the pencil beam centred pixel. The kernels obtained are fitted to equation (3) ² formed with amplitude factor $c$ given by equation (4) and form function $g$ given by equation (5) made of two symmetric gaussian functions. Only a few thickness kernels are simulated, for the rest of the

$$I_s(m,n) = \sum \sum I_p(k,l) h_{k,l}(m-k,n-l)$$

$$I_s(k,l) = \frac{1}{\mu} \log \left( \frac{I_p(k,l)}{I_p(k,l)} \right)$$

$$h_{k,l}(m-k,n-l) = C(k,l) g(m-k,n-l)$$

$$C(k,l) = \left( \frac{I_p(k,l)}{I_p(k,l)} \right)^{\frac{1}{\mu}}$$

$$g(n-k,n-l) = e^{-(\frac{n-k}{\sigma^2})}$$

Results and Discussion

- Two scatter correction approaches :
  - Discrete Kernels: one average value of parameters for three thickness ranges 0-10 mm, 10-20 mm, 20 mm and above
  - Continuous Kernels: and interpolated kernel parameters wrt thickness
  - Figure 4 gives horizontal and vertical profiles of the uncorrected and corrected projections
  - Better edge enhancement by continuous approach than discrete approach due to better sampling of kernels
  - Figure 6 shows the plot profile of the uncorrected and corrected reconstruction slices
  - Obtained result is in agreement with the value of linear attenuation coefficient per cm for mean energy 320 keV (0.83 per cm)
  - The result is also in agreement with correction performed using beam stop arrays method by A. Peterzol [8] which requires many acquisitions for the correction.

Conclusion and Perspectives

Scatter correction with SKS approach on high SPR data shows interesting results correcting together scatter due to object and detector both in NDT energy range. Continuous SKS approach clearly shows better edge enhancement as compared to discrete approach. To check the efficiency of the method for other energy ranges, the correction of data for medical range and MeV range are in progress.

References


Figure 7: Picture of iron hub sample [5]