STREAK-REDUCED HUMAN-SCALE DARK-FIELD CT WITH 3D GAUSSIAN SPLATTING

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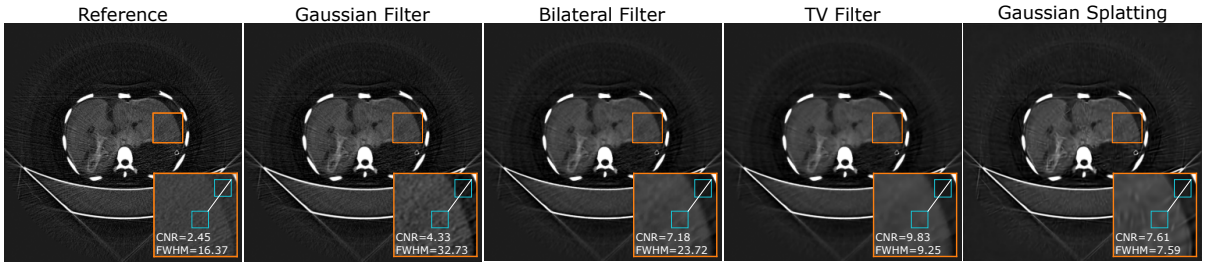

Fig. 1. Example axial DFCT slice, without (reference) and with streak-reduction post-processing. The CNR and FWHM values for the 20×20 pixel lung tissue and air regions (blue) are provided. The white line is used for pixel-wise FWHM calculation.

1. INTRODUCTION

The clinical dark-field CT scanner (DFCT) enables attenuation- and small-angle scatter-based imaging of human-scale phantoms. Due to the scanner's vibrating Talbot-Lau grating interferometer, images suffer from inherent streak artifacts [1]. In this work, DFCT data is processed by re-purposing the 3D Gaussian Splatting (3DGS) method, designed for rendering sparsely sampled X-ray attenuation data [2], and is compared against conventional filtering.

2. METHODS

A ventilated ex vivo porcine lung placed inside an anthropomorphic Lungman phantom (Kyoto Kagaku, Tokyo, Japan) was measured at 20 randomly selected table positions, and reconstructed with the filtered back-projection algorithm at the clinical DFCT setup [1]. Gaussian, bilateral, and total variation (TV) filters, and the re-purposed 3DGS model from [2] were explored for post-processing DFCT data. For each conventional filter, the hyperparameters were optimized via grid search, maximizing the structural similarity index between 3DGS and the filtered image on a global image-level. The contrast-to-noise ratio (CNR) and the full-width-at-half-maximum (FWHM) of manually-selected 20×20 pixel regions of lung tissue and air were calculated, as in Fig. 1.

3. RESULTS AND CONCLUSION

The resulting mean and standard deviation values are: for the reference scan (CNR = 2.44 ± 0.93, FWHM = 40.25 ± 11.32), Gaussian filter (CNR = 4.14 ± 1.48, FWHM = 31.99 ± 16.22), bilateral filter (CNR = 6.44 ± 2.60, FWHM = 23.36 ± 16.33), TV (CNR = 8.09 ± 3.47, FWHM = 15.78 ± 16.21), and 3DGS (CNR = 6.74 ± 2.51, FWHM = 10.06 ± 8.83). These findings indicate that 3DGS outperforms conventional filtering in DFCT streak-reduction, preserving edge sharpness and a high CNR, a necessity for diagnostic accuracy in future clinical trials.

4. REFERENCES

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