AbstractID: 10574 Title: Contrast Mechanism and Origin of Artifacts in Phase-Sensitive X-Ray Volumetric Imaging

Purpose: Phase-sensitive x-ray volumetric imaging has great potential for tissue contrast enhancement and radiation dose reduction, compared to conventional tissue-attenuation based x-ray volumetric imaging. In order to achieve quantitative and artifact-free phase sensitive volumetric imaging, one should quantify the formed phase contrast and find the origin of artifacts formed in phase-sensitive volumetric imaging. **Method and Materials:** We incorporated x-ray Fresnel diffraction into x-ray projection acquisitions, and reconstructed volumetric images from these phase-sensitive projections by the filtered backprojection method. A formula for the reconstructed tissue's apparent attenuation coefficients was derived for quantitative analysis. Computer simulations of phase sensitive 3D tomography were performed, and reconstructed 3D phantom tomograms were analyzed, and the artifacts associated with phase-contrast were identified. In order to eliminate these artifacts, we performed phase retrievals based on the phase-attenuation duality method for each projection, and these phase-retrieved projections were then used for new 3D tomographic reconstructions. **Results:** The apparent linear attenuation coefficients in 3D tomograms were found each being the sum of three parts: the tissue linear attenuation coefficient, the scaled 3D Laplacian of tissue refraction index, and the artifact depending on global distributions of tissue attenuation coefficients and refraction indices. The simulated high-resolution 3D images of phantoms exhibit severe artifacts as the upward and downward density over-shootings and the streaks. The phase retrieval was shown very effective for removing these artifacts and accurately reconstructing tissue attenuation coefficients in phase-sensitive 3D tomography. **Conclusion:** We clarified the contrast mechanism in phase-sensitive volumetric imaging, found the quantitative contribution of the phase contrast in reconstructed 3D images, and revealed the origin of severe artifacts. The need of the phase-retrievals for quantitative and artifact-free phase sensitive volumetric imaging was clearly demonstrated.

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