AbstractID: 12826 Title: Improving Robustness of Phase Retrieval in X-Ray Phase Contrast Imaging

Purpose: The phase retrieval, retrieving tissue phase maps from the x-ray phase contrast images, is an important task in x-ray phase-sensitive imaging. The robustness of phase retrieval algorithms is of critical importance for reducing radiation doses in clinical applications. We show that the conventional phase retrieval method is actually unstable against the quantum noise. We present a more robust phase retrieval method that we developed. **Method and Materials:** We first studied the phase retrieval by means of the conventional Transport of Intensity Equation (TIE) method for phantom imaging (such as a nylon air bubble wrap). For improvement we developed a robust phase retrieval method based on our notion of the phase–attenuation duality and attenuation partition, and derived a robust iterative phase retrieval algorithm. This algorithm had been applied to experimental phase contrast imaging with phantoms. In addition the phase retrieval accuracies had been analyzed with computer simulations of phase contrast imaging of a digital phantom of breast tissue characteristics. **Results:** We found that the TIE-based phase-retrieval suffers from an intrinsic singularity. The phantom imaging showed that the TIE-based phase retrieval method is unstable against the noise and misalignment in phase contrast imaging, even if the Tikhonov regularization was employed. In contrast, our method based on the phase–attenuation duality and attenuation partition is singularity-free, and is robust in terms of the phase-map image quality and phase-map accuracies against the noise and misalignment, as is verified by means of experimental phantom imaging and computer simulation. **Conclusion**: The conventional TIE-based phase retrieval method is unstable against noise and image misalignment. Our phase retrieval method method based on the phase–attenuation duality and attenuation partition is robust against the noise and image misalignment.

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