

X-Ray Phase-Attenuation Duality and Phase Retrieval For Soft Tissue Imaging

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Phase-retrieval is the key to the quantitative x-ray phase-contrast imaging of soft tissues. In order to retrieve a phase image of tissues, multiple phase-contrast images are needed in general. While the current TIE-based retrieval approach is largely successful, the approach requires low-level noise for retrieval-accuracy. In clinical imaging it would be desirable to find a way to retrieve the tissue phase-map from a single phase-contrast image for reducing the radiation dose and the artifacts associated with motion. Moreover a robust phase-retrieval approach is desirable to limit tissue-radiation doses to a reasonable level.

Quite recently we made a new observation of the phase-attenuation duality for soft tissues, and we showed how only a single phase-contrast image is needed for a successful phase-retrieval for inhomogeneous soft-tissues based on this duality [1]. In this talk the phase-retrieval formula in [1] will be discussed in more details. In addition we show how to extend the phase-retrieval formula into cases of polychromatic and partially coherent x-ray encountered in clinical imaging. The high robustness of these retrieval algorithms will be rigorously established. Taking the mammography as an example, we show that this new phase-retrieval approach based on the phase-attenuation duality may result in striking enhancement of mammography contrast-noise ratio per unit average glandular dose to beast.

Reference

[1] - X. Wu, H. Liu and A. Yan, Optics Letters 30: 379, (2005).