

# Characterization of transfer functions of double-layered detectors for dual-energy x-ray imaging

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Dual-energy imaging (DEI) usually uses double exposures of x-ray beam at two different energies and results in tissue or material-selective images. The DEI can also be achieved at single exposure using a specialized detector that is configured two detector layers in tandem. The thin front layer relatively absorbs low-energy x-ray photons and the thick rear layer relatively absorbs high-energy photons transmitted through the front layer. Therefore, this double-layered detector shows unique transfer function characteristics because of different spatial-resolution characteristics of the two detector layers and the weighted combination of two images for DE reconstruction. Fig. 1 compares the DE images obtained using the double-shot and single-shot methods and apparently shows sharpened edges in the single-shot DE image as if the unsharp masking process were applied to the image. The authors theoretically demonstrate that the transfer function of the double-layered detector can improve image contrast at high spatial frequencies. The theory is validated by comparing the measured modulation-transfer function. Moreover, the authors quantitatively discuss the unique characteristics of the transfer functions are different from the unsharp-masking digital image processing. Although the contrast-to-noise performance of the single-shot method is inferior compared to the double-shot method because of lower energy separation between two images, its unique transfer characteristics may be attractive to some x-ray imaging applications, which require high contrast at mid and high spatial frequencies while sacrificing the contrast at low frequencies, such as industrial non-destructive inspection.

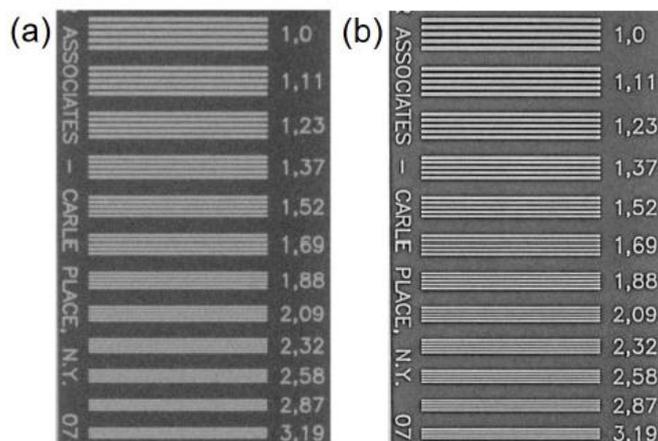


Fig. 1. Comparison of line-pair phantom images obtained from (a) the dual-shot DEI method by switching the tube voltage settings between 60 kVp and 90 kVp and (b) the single-shot DEI method at 90 kVp.

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