Purpose:Investigations over the past few years have demonstrated some of the benefits and shortfalls of tomosynthesis in radiation therapy for patient positioning or dose tracking. Tomosynthesis generates excellent image quality in one reconstruction plane; however, there is a loss of edge and frequency information in the additional planes due to the spatial incompleteness of the projection data. In this study, we investigate the results of a new discrete frequency interpolation technique (DFIT), which is used to incorporate tomosynthesis limited arc projection data and three additional "filling" projections.

Methods:For the initial investigations, we simulated a Shepp-Logan phantom with parallel beam geometry to generate 93 projections. 90 of these projections were over a tomosynthetic arc at one projection per degree. The remaining three projections were generated to fill in the next 90 degrees evenly (i.e. 22.5, 45, and 67.5 degrees from the end of the arc) to help "fill in" the incomplete data. Simple filtered backprojection (FBP) results show no improvement as FBP is designed for uniform distribution of projections. Per the projection slice theorem, the tomosynthesis data fills in a portion of the frequency plane. The remaining sparsely sampled area of the frequency plane is filled using linear interpolation from the end arc projections and the 3 discrete projections. The DFIT image is the sum of the FBP image and the inverse Fourier transform of the interpolated frequencies

Results:The images by traditional FBP and DFIT are compared visually and using line profile plots. Additionally, contrast results are examined. The DFIT images show improved edge delineation in the usual tomosynthesis "blurred" direction and improves reconstructed contrast.

Conclusions:The addition of limited "filling" discrete projections and DFIT can be used to improve the reconstruction accuracy and quality of short arc imaging.

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