AbstractID: 3923 Title: Exact fan-beam image reconstruction algorithm for a specific truncation problem: asymmetrically positioned half-size detector

**Purpose**: In nuclear medicine imaging, diagnostic x-ray CT imaging, and image guided radiation therapy truncation of the projection data may be present due to patient motion, inaccurate positioning or simply an insufficient detector. For fan-beam geometry, images reconstructed with truncated data suffer sever artifacts when reconstructed with the conventional filtered backprojection (FBP) algorithm. A new exact fan-beam image reconstruction algorithm is developed to solve a special case of the data truncation problem. In this configuration, fan-beam projection data are acquired using an asymmetric detector that covers only half of the field of view.

**Methods**: In order to solve this data truncation problem, the newly developed fan-beam image reconstruction algorithm via filtering the backprojection image of the differentiated projection data (FBPD) was employed. This algorithm enables line by line reconstruction in image space. The following observations about this FBPD algorithm are crucial to solve the data truncation problem: (1) for a given point in the backprojection image space, only one projection from each view angle is required to properly construct the backprojection image; (2) for each ray passing through a given image point from one source position, there is a conjugate ray passing through the same point. With truncated data, a $2\pi$ full scan is required to reconstruct the whole object, and a ROI reconstruction can be obtained using projection data from less than a $2\pi$ full scan.

**Results**: Numerical simulations have been conducted using a Shepp-Logan phantom. Images reconstructed from the truncated data for scans of the entire object validate this reconstruction algorithm for the full $2\pi$ scan. In addition ROI reconstruction has been validated using projection data from less than a $2\pi$ full scan.

**Conclusion**: This algorithm enables exact fan-beam image reconstruction from projection data acquired using an asymmetric detector which covers only half of the field of view.