AbstractID: 5373 Title: A Local Fourier Description of Artifacts in Circular Cone Beam Computed Tomography

Purpose: Circular cone-beam computed tomography is challenged by a lack of plane sums resulting in incomplete inversion of the radon transform. These missing plane sums have been identified by theory, and may be represented as a shift-variant cone of missing frequencies in the Fourier domain. The aim was to verify the presence of this cone in real data, and to show the dependency of resulting image artifacts on the frequency distribution of the imaged object.

Method and Materials: A mini disk phantom (mylar/foam) was constructed to probe the local frequency response at various locations in the reconstruction space. Projections obtained using an experimental CBCT benchtop were reconstructed with 120 μm^3 voxel size using a modified Feldkamp filtered backprojection routine. Local Fourier transforms of the mini disks were analyzed for missing frequency data and compared with theory. Large disk phantoms of acrylic and cellular polyurethane were also imaged for further demonstration of the effect of varying the frequency content of the imaged object.

Results: The cone of missing frequency was successfully identified in the mini disk phantom and agreed well with theory. Image artifact was found to have dependency on the local distribution of the object's frequency power spectrum relative to the cone of missing frequency information. Decreased resolution of the disks occurred when their dominant spatial frequency components were directionally aligned to coincide with the predicted null cone, as expected. Image reconstructions of large disk phantoms showed good detail in cellular disks even at locations that showed strong artifacts in the acrylic disk.

Conclusion: The predicted null cone is observable in Fourier transforms of localized objects. Resolution in reconstruction is dependent on the relative frequency distribution of the imaged object; features that are most poorly resolved will be those with strong frequency components directed in the expected null space.