AbstractID: 13726 Title: Reconstruction of a cone-beam CT image via forward iterative projection matching

Purpose: This work is demonstrates the feasibility of reconstructing a cone-beam CT (CBCT) image by deformably altering a prior fan-beam CT (FBCT) such that it matches the anatomy portrayed in the cone-beam projection data set. **Method and Materials:** The process is demonstrated via simulation using a numerical phantom as a source CT image. A known deformation is applied to the phantom resulting in a deformed CT image, and a cone-beam projection data set is simulated and used as a target projection data set. A parameterized deformation model is applied to the source CT image and digitally-reconstructed radiographs (DRRs) are calculated. The DRRs are then compared to the target projection data set and the deformation model parameters are adjusted. This is repeated until the DRRs optimally match the target projections. The resultant deformation and deformed CT image are then compared to the known deformation and known deformed CT image. The sensitivity of the process to projection mismatch is explored by adding noise to the target projection data set and perturbing the contrast of the DRRs. **Results:** When there is no noise or contrast mismatch in the cone-beam projection images, a set of 64 projections allows a known deformation to be reconstructed to within 2.84% nRMS error and the known CT to within a 1.79% nRMS error. Deformation errors of <6.5% and CT errors of <5% are sustained at levels of noise and DRR contrast mismatch that exceed what would ordinarily be observed in real cone-beam projections. **Conclusion:** By using prior knowledge available in a FBCT, we show that a CBCT image can be iteratively reconstructed from cone-beam projection images. Because the method preserves the CT numbers of the FBCT, the resulting 3D image intensities will be more accurate than a CBCT reconstructed via conventional back projection methods.