AbstractID: 9351 Title: Low dose flat-panel cone-beam CT and tomosynthesis for interventional guidance via Prior Image Constrained Compressed Sensing (PICCS)

**Purpose**: Intra-operative three dimensional imaging via FP-CBCT (flat-panel cone-beam computed tomography) offers high spatial resolution and the ability to image low contrast structures such as soft-tissue. However, repeated FP-CBCT scanning requires irradiation of the patient for each subsequent acquisition. The aim of this work is to significantly reduce the delivered dose for monitoring and verification scanning, by using a planning scan to constrain the reconstruction.

**Method and Materials:** An extension to compressed sensing (CS) has recently been proposed wherein a prior image is utilized as a constraint in the image reconstruction procedure (i.e. Prior Image Constrained Compressed Sensing - PICCS). The PICCS framework was used here on a clinical neuro-interventional C-arm system. Geometric calibration was incorporated into the algorithm through measured projection matrices of a known phantom.

**Results:** The clinical task of placing a needle into a target was simulated with phantom and cadaver experiments. A full range of tomographic angles was explored from 10 degrees to 200 degrees. In the phantom experiments the delivered dose used for the reconstruction was twenty times less than the planning image. In the cadaver experiments PICCS images were reconstructed with a dose reduction factor of ten. The needle was well visualized in the tomosynthetic planes (e.g. coronal planes for a PA arc) for all acquisitions and the PICCS algorithm enabled improved reconstruction of the background anatomy compared with CS and standard FBP.

**Conclusion:** The PICCS algorithm enabled reconstruction of the needle introduced from few views, while maintaining the background anatomy. If a tomosynthesis acquisition is chosen the orientation of the arc with respect to the object of interest is no less important than with standard image reconstruction. Experimental data indicates that a significant undersampling is acceptable (e.g. an order of magnitude dose savings) when using the PICCS reconstruction algorithm.