AbstractID: 5758 Title: Evaluation of the quality of 3D-3D mutual information (MI) shared between reference and on-board DTS images.

Purpose: Digital tomosynthesis (DTS) is a fast, low-dose method for reconstructing 3-D slices from 2-D cone-beam x-ray projection data acquired with limited source angulation (e.g., 40^o). We previously developed a method for reconstructing reference DTS (RDTS) images from a planning CT volume, for registration with on-board DTS image data. This study examines 3D-3D mutual information (MI) shared between RDTS and DTS volumes of an anthropomorphic chest phantom.

Method and Materials:
Planning CT and on-board CBCT volumes of an anthropomorphic chest phantom were aligned by a point-registration of 6 metal fiducials. Misregistration (+/- 5mm and +/- 5^o) was simulated along each of the six possible translational and rotational dimensions of the planning CT volume. For scan angles spanning 10^o-60^o, RDTS images were reconstructed from each of the misregistered CT volumes and DTS image sets were computed from actual on-board projections. 3D-3D MI between each RDTS and DTS volume was computed for a 4cm x 10cm x 7.5cm central region of interest containing the spine. MI was plotted as a function of each of the six possible translations and rotations, for each DTS scan angle.

Results:
For all scan angles greater than 10^o, residual error in the location of global MI maxima was less than 1.0 mm, and 0.5^o. MI resolution to shifts in the depth dimension (normal to individual DTS planes) improved noticeably with increasing scan angle. MI sensitivity to all other shifts and rotations showed only minor improvement with increasing scan angle.

Conclusion:
MI between planning CT-generated RDTS and actual on-board DTS image data is sufficient to be used for rigid-body registration purposes. The addition of an orthogonal DTS acquisition (i.e., acquiring sagittal along with coronal DTS) is probably unnecessary for rigid-body DTS registration.

Conflict of Interest:
This research was supported in part by a grant from Varian Medical Systems.