

AbstractID: 6585 Title: Development of Clinical Application Platform Using Digital Tomosynthesis for Target Localization

Purpose: To develop a workstation for clinical application of digital tomosynthesis (DTS) for real-time target localization. Specifically, to accelerate the reconstruction both digitally-reconstructed radiograph (DRR) and DTS using ultra-fast interpolation capability of graphics hardware.

Method and Materials: The developed workstation for real-time target localization using DTS technology includes image acquisition, image reconstruction, and image comparison. A critical step to implement this technology is its reconstruction speed, especially real-time generation of reference DTSs which require DRRs. The new generation graphics hardware provides a fast implementation of image interpolation and allows the bi-linear/tri-linear interpolation and the other image operations to be accomplished within second. We implemented classical ray-casting algorithm for 2D DRR and filtered back-projection (FBP) algorithm for DTS reconstruction on graphics hardware based on OpenGL programming interface. Specifically, planning CT images and on-board projection images were loaded into the memory of hardware and saved as textures which were projected onto frame-buffer according to the given geometry of imaging system. The final images were generated by blending multiple textures projected onto the frame-buffer. Difference images and correlation coefficients between hardware and software DRRs and DTSs were calculated to assess their similarity.

Results: The mean errors and their standard deviations of the differences DRR and DTS images are $1.0\% \pm 1.5\%$ and $1.2\% \pm 2.1\%$. The correlation coefficients are 99.9% for DRRs and 99.5% for DTS. The reconstructed efficiency was improved by a factor of 67 for DRR and 13 for DTS.

Conclusions: The hardware method provides fast reconstructions of DRR and DTS with visibility of anatomical structures comparable to those generated using software methods. This allows real-time target localization for image registration between on-board and reference DTSs in the application platform.