

AbstractID: 7494 Title: Automatic Optical Tracking System Calibration for Radiation Therapy

Purpose: Optical tracking systems provide high-resolution real-time positioning data. To provide clinically beneficial data in a radiation therapy context the optical tracking system's coordinate system must be registered to the isocentric coordinate system of the treatment delivery room. Current systems use a rigid phantom aligned relative to the isocenter, often using in-room lasers. An algorithm has been developed which allows the automatic registration to the isocentric coordinate system using a calibration phantom and cone-beam CT (CBCT).

Methods and Materials: A custom calibration phantom with passive infrared reflective markers was designed for use in conjunction with the Polaris, an IR emitting stereoscopic camera (NDI, Waterloo). The phantom was placed on the treatment couch of a linear accelerator (Elekta Synergy) within the field-of-view of the kV source and CBCT acquired. The reconstructed volume was imported into custom in-house software. The four reflective markers on the phantom were automatically localized inside the volume using a novel template matching algorithm. The software also retrieved the coordinates of these same markers from the unregistered camera. Using the two point sets, a rigid transformation was computed using a least squares fit, allowing the camera's coordinate system to be calibrated to the isocentric CBCT coordinate system. After calibration five reflective markers were placed on the treatment couch and their positions captured using three methods: infrared camera, CBCT, and orthogonal EPIDs. The 3D marker positions in each reference frame were then analyzed.

Results: The error between the infrared camera and CBCT, infrared camera and orthogonal EPIDs, and CBCT and orthogonal EPIDs for the marker positions was 1.93, 1.81, and 1.31mm(RMS), respectively.

Conclusion: Calibration errors are within the precision requirements for radiation therapy patient positioning aids (<2mm). By automating the procedure the subjectivity is reduced and the reproducibility is increased.