Abstract ID: 16409 Title: An EPID Based Method for High Accuracy of Spatial Registration Between An Optical Tracking Device with the LINAC Reference Frame

Purpose: The accuracy of an optical camera system used for patient motion monitoring is typically limited to 1-2 mm due to use of the light field crosshair and in-room lasers for initial camera calibration setup making it unsuitable for highly accurate patient monitoring procedures such as frameless SRS. To provide submillimeter accuracy in calibrating a 3D stereoscopic infrared optical camera with the treatment frame of a LINAC, a semi-automated calibration method was developed based on simultaneous viewing of external markers with both the MV treatment beam and optical camera system.

Methods: A phantom comprised of 9 steel BBs covered in highly IR reflective tape was placed on the LINAC treatment couch and imaged with both a 3D stereoscopic IR imager, and the on board MV EPID imager at a variety of gantry angles. Using the relative 3D BB positions given by the camera,simulated annealing was used to optimize 9 parameters including source-to-imager distance, detector tilt, and deviations from nominal isocenter. Singular value decomposition was then used to calculate the transformation between different reference frames. Additionally, a traditional method of calibration was used for comparison.

Results: Using modeled data, the simulated annealing process was able to determine the locations of the BBs with .2 mm accuracy. Using projection images acquired with an MV imager, initial preliminary results show the ability to determine locations of BBs with a .2 mm planar standard deviation and a 1 mm axial standard deviation.

Conclusions:The method can be used to provide a highly accurate spatial registration between an external 3D camera frame and the LINAC frame. The real MV imager results, while not as precise as the simulated results, exceed current standards and are expected to improve with continued refinement.