AbstractID: 10875 Title: A method for alignment test of an X-ray positioning system for proton therapy

Purpose: To develop a method to test the alignment of an on-board x-ray positioning system for proton therapy.
Methods and materials: Each treatment portal at the proton therapy center in Houston (PTC-H) is equipped with three orthogonal x-ray imaging devices. We developed a method to test the alignment of imaging devices using a custom built phantom. The phantom is 30 x 30 x 30 cm in size and is positioned on a base plate, which attaches to the robotic patient couch. The phantom position was calibrated against a 2-mm diameter tungsten ball placed at radiation isocenter. On each side of the phantom, there are radiopaque markers of known sizes and locations. With the measurement of the marker locations in the x-ray images, we calculated the alignment of the x-ray source to that of the major axis of the proton machine reference frame. By using points 15 cm away from isocenter, we test the alignment not only with iso center, but also with the reference frame axes to avoid angulations between imaging axis and machine axis. We also derived source-to-axis-distance (SAD), source-to-imager distance (SID) for the x-ray source, and pixel size for the image receptor. The phantom design allowed for alignment of all three imaging systems without couch movement once the phantom was positioned at isocenter.
Results: We used this method to test the alignment of imaging positioning system at a proton portal at PTC-H. We found the measured results to be within 0.4 mm at iso for x-ray sources alignment at all 3 x-ray/receptor systems at gantry of 270 degree. The pixel size was within 1%. SAD, SID were within 2% of manufacturer's specifications.
Conclusion:We developed a method to align the x-ray positioning system for a proton gantry to the precision necessary for proton therapy.