AbstractID: 7601 Title: Prototype fixture for IGRT coordinate registration and 4D CT reconstruction

Purpose: The potential use of in-room CT technology for target localization requires accurate methods for mapping spatial and temporal data between the CT and linac coordinate spaces. This can be done by absolute calibration of the imaging device prior to scanning or by capturing known fiducial patterns within the image data. We have designed a hybrid technique for in-room CTs that defines a unified coordinate system referenced to the treatment table. It is based on patterns encoded in the unused portion of CT images below the treatment table surface. These patterns have two primary functions: 1) to facilitate the registration of image coordinates for image-guided radiation therapy; and 2) to encode an external respiratory signal for 4D CT reconstruction.

Methods and Materials: A fixture was made from a 6 mm thick acrylic plate embedded with small aluminum rods. The rods formed a pattern used for spatial calibration. In addition, a long "V" shaped piece of extruded aluminum was mounted on the fixture between bearings and attached to a motor. The motor was computer controlled such that the "V" could point in any direction to encode a respiratory signal. The entire fixture was mounted beneath the "tennis racket" portion of a carbon fiber treatment table.

Results: CT images clearly showed the spatial patterns and respiratory signal encoded by the fixture. Dynamic respiratory signals were imaged with minimal artifacts at angular velocities up to six rpm with 0.8s CT gantry rotation. Custom software was able to decode the image metadata and use it for IGRT coordinate registration and 4D CT reconstruction. Attenuation of 6 MV radiation by the fixture was measured to be < 3%.

Conclusions: The prototype met all design goals and facilitated IGRT coordinate registration and 4D CT reconstruction.

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