

AbstractID:9063Title:Patient setup using 2D projected images and setup error estimation

Purpose: Fiducial markers or bone structure are widely used in patient setup for image-guided therapies and is also important in interventional radiology. A general approach ("2D-2D") for patient setup is based on 2D projected images on the anterior-posterior (AP) and lateral (LAT) directions. However, it is still an open question to decide the number of fiducial markers required for patient setup, the optimal locations for marker placement, the selection of fiducial markers *versus* bone structure, and the error estimations of different setup methods. Our work will address some of these issues and provide quantitative information.

Method and Materials: Clinical patient setup procedure ("2D-2D") is simulated using rigid registration. Least square metrics are applied to minimize the alignment error of markers. Registration under different degrees of freedom (DOF) are performed, including 3DOF (translation only), 4DOF (translation and AP couch rotation) and 5DOF (translation and rotation on AP and LAT). Registration errors are calculated based on absolute or percentage of missed volume between estimated tumor location and real tumor location.

Results: Patient setup errors were investigated using different registration methods under various tumor motion conditions. The results showed that back and forth shifts using alternating projection planes can worsen the registration of the target center with each "correction" step given a target rotation. Second, for off-center rotations of five degrees, no alignment can result in smaller errors than 2D-2D registrations, despite a translation of the target center. In addition, a 3DOF alignment process performs better against rotational shifts than both 4DOF and 5DOF, though rotations with respect to projection planes.

Conclusion: The quantitative analysis and setup error estimation using "2D-2D" registration will provide better guidance for patient setup, which is important for effective radiation treatment of cancer patients.