

Purpose: To develop and evaluate an optical patient-alignment system to assist in patient positioning during breast radiotherapy. Since the breast is a deformable organ of variable size and shape, standard setup procedures may be inadequate to position the breast properly for treatment.

Methods: This method employs a standard digital camera, and an in-house constructed calibration phantom (CP), composed of ten identifiable reflecting spheres, mounted on a wooden platform. A CT image of the CP was acquired, to determine the 3D configuration of the spheres. For calibration, the CP is placed on the treatment couch and aligned to the collimator. A digital photograph of the CP is acquired, and a centroid-finding technique is applied to this image to obtain the 2D coordinates of the spheres. These 2D coordinates, along with the known 3D model of the spheres, serves as input to an optimization routine based on the downhill-simplex algorithm. The routine solves for the geometry of the camera location; i.e., the rotation and translation relating the camera to the CP, and therefore to the treatment room geometry. Using this information about the camera parameters, the 3D CT data can be projected onto the camera's imaging plane, and displayed on a monitor, superimposed on a live video of the patient. This would enable the therapist to view both the patient's current and desired positions, and guide in proper positioning.

Results: In order to evaluate our method accuracy, simulated images were created of a virtual CP. Our results demonstrate an accuracy of 0.2 cm and 0.1 degrees, respectively, in translation and rotation.

Conclusions: we developed a method to calibrate an optical camera system, which can be used to superimpose a perspective projection of a CT image on a patient's real-time optical image. Displaying this visual information will assist in accurate setup during breast radiotherapy