

We have developed a method of calibrating external video camera systems to the beam coordinate system of radiotherapy linear accelerators. There has been recent interest in using digital camera systems external to the radiotherapy machine to aid in positioning patients for fractionated radiotherapy. There exists a need to know the geometrical relationship between the beam coordinates of the treatment machine and the camera system. The technique we have developed utilizes a 3-D calibration phantom visible in both X-ray and optical images. Portal images of the calibration phantom on the treatment couch are taken using several gantry and couch positions. Using the known configuration of the calibration points and the corresponding 2-D position in the images, the parameters of pinhole camera geometry are found by minimizing the mean squared error between the image and predicted points. The calibrated portal images are then used to model the gantry and couch axes of rotation as two axes of a Cartesian coordinate system. We have applied this technique using a Varian Clinac 2100C with the PortalVision EPID and a hand held color digital camera. A correlation between the gantry and couch angles and the corresponding angles predicted by the calibration was measured to be 1.0031 with R-square of 1.0015 and 1.0010 with R-square of 1.0007. This demonstrates the ability of the calibration to model the motion of the treatment machine well. Calibration of video camera systems using this technique is accurate and provides a method to make absolute measurements in the beam coordinate system.