

We have developed an automated image registration algorithm that is able to map dose distribution obtained via film to that calculated from the planning system for the purpose of IMRT quality assurance. The scanned films are first transformed using a transformation matrix that is determined by the scaling (S), rotation ($\Delta\theta_x$, $\Delta\theta_y$), and translation (Δx , Δy) parameters. In this step the scanned film serves as the “template” because it has a much higher resolution, *i.e.*, pixel size 0.35mm×0.35mm, than the 3D dose matrix volumetric data (voxel size 2.5mm×2.5mm×2.5mm). We then calculate the mutual information between film and the corresponding 2D slice of the dose matrix. Using a gradient search based method we find the optimal transformation parameters that maximizes the mutual information. The algorithm was tested against the gold standard, *i.e.*, marker-based image correlation method. Both axial and traverse orientation films were taken for assessment. For the nine films we tested, the difference between the gold standard and our algorithm are: translation (1.8mm±0.4mm, 1.6mm±0.5mm), rotation (1.1°±0.4°, 0.5°±0.2°), and scaling (0.09±0.11). Our algorithm achieves subpixel accuracy. Compared with correlation based evaluation algorithm, our algorithm (1) does not require markers brought in via special designed phantom or additional MLC sequences, thus can work with any orientation and save time; (2) does not require any film calibration procedure since mutual information matching automatically gives the dose-optical density curve; (3) produces an evaluation index, *i.e.*, maximized mutual information, that can be used for an overall assessment of quality.