AbstractID: 8505 Title: A robust algorithm for detecting radiation field centers in electronic portal images with subpixel accuracy

Purpose: In linac-based intracranial or extracranial radiosurgery, it is crucial to identify radiation centers for patient setup and treatment. This project is to develop a Hough transform (HT)-based algorithm for detecting radiation field centers with subpixel accuracy using electronic portal images.

Method and Materials: Electronic portal images of circular radiation fields were simulated numerically. The center location at subpixel level, field size, penumbra width, and signal-to-noise ratio (SNR) were made variable in order to test the accuracy of center detection algorithms. Hough transform was applied to the gradient images of the simulated fields. The location of the peak accumulator cell in Hough space were determined and used to derive the radiation center in image space.

Results: The algorithm located the radiation center within 0.024 ± 0.018 pixels (mean $\pm$ standard deviation) for typical circular fields with a radius of 20 pixels, SNR of 40, and varying center locations. Subpixel accuracy, i.e., error less than one pixel size, was achieved for all tested field sizes ranging from 2 to 40 pixels in radius and SNR ranging from 2 to 100. Errors larger than 0.5 pixel size occurred only in extreme conditions, e.g., when SNR ≤ 4. Comparison with the center of mass (CM) method indicated that the HT method is superior in images with or without a number of image artifacts.

Conclusions: This work demonstrates that the radiation centers can be determined with subpixel accuracy in electronic portal images. The HT-based algorithm is robust to image noise and various image artifacts that may cause the CM method to fail. This method may be implemented as a key step in aligning patient precisely for stereotactic radiosurgery and image-guided radiation therapy.