AbstractID: 10860 Title: Incorporation of setup uncertainties through Gaussian convolution of the dose distribution

Purpose: The purpose of this work was to evaluate the simulation of setup uncertainty by convolve the dose distribution calculated by the treatment planning system with a Gaussian kernel.

Materials and Methods: Setup uncertainty was explicitly simulated by targeting many beams at isocenters that were displaced in such a way that the original isocenter was surrounded symmetrically in R3 space, imitating a patient displacement relative to the position in the original treatment plan. The weighting of the displaced beams was made proportional to a Gaussian probability distribution for several choices of σ. The dose distribution created by multiple beams was compared to the dose distribution created by a Gaussian convolution of the original beam setup using the gamma metric. A commercial radiation treatment planning system (Pinnacle^3, Philips Medical Systems, Milpitas CA) was programmed to collect 2,197 beam dose grids for each treatment beam in each of 3 evaluated treatment plans (totaling 32,955 beam dose grids) in order to collect a large sample of displaced isocenters. Subsequent analysis was performed using custom software in MATLAB (The MathWorks, Inc., Natick, MA).

Results: For all choices of σ, the gamma values associated with voxels of the plan's regions of interest are almost entirely below 0.4 to 0.5, with only several voxels from many thousands having values from 1.0 to 1.4.

Conclusions: The application of a Gaussian convolution is an accurate method of approximating the final dose as it would be delivered by multiple beams randomly displaced from their intended isocenter in the patient, implying that this application is suitable for simulating the effect of setup uncertainty on the treatment plan.

AbstractID: 10860 Title: Incorporation of setup uncertainties through Gaussian convolution of the dose distribution

This work has been supported in part by a Sponsored Research Agreement with Philips Healthcare.