AbstractID: 1596 Title: A Planning Target Volume Margin Calculator Tool

Optimized planning target volumes (PTV) that account for geometric uncertainties can significantly enhance the efficacy of radiation therapy. The PTV is defined by adding a margin to the clinical target volume to account for patient repositioning uncertainty and organ motion. While ICRU report 50 defines the PTV, it does not specify how to generate the volume. We present a 'margin calculator' that generates a PTV based on specified goals and explicit modeling of geometric uncertainties. This model explicitly accounts for three-dimensional dose gradients and the number of treatment fractions. Five input elements are required: anatomical contours, a dose distribution, retrospectively measured distributions of random and systematic uncertainty, and a specified dosimetric treatment tolerance goal. Either deterministic or Monte Carlo-based modeling of geometric uncertainties can performed. The impact of geometric uncertainties on the treatment is simulated to determine if the treatment goal is met with the desired probability. If so, the simulation returns the current PTV. If the probability is less than requested, the dose distribution and PTV are geometrically scaled and used as input to another iteration of the simulation. This process is repeated until the treatment goal is met with the desired probability. The utility of the margin calculator is demonstrated with the example of a conformal prostate treatment. The margin calculator allows the design of PTVs that meet specific treatment goals with specified probabilities. These PTVs should result in patient-specific treatments that maximize the utilization of the shrinking geometric uncertainties made possible through image-guided therapy.