

Optimal constraint dose of an overlap region between target and critical structure for inverse treatment planning

The aim of inverse treatment planning is to design a plan to deliver a prescribed dose to target volume and minimize the dose to critical structures. Since the planning target volume (PTV) includes a spatial margin, usually PTV overlaps the volumes of one or more critical structures. A question is what dose we should use as a goal of optimization for this overlap region. To determine an optimal constraint dose to the overlap regions we propose to use biological indices of target and critical structures: tumor control probability (TCP) and normal tissue complication probability (NTCP). We assume a simple geometry consisting of a PTV and a critical structure. We include the effect of the organ motion by defining the probability that PTV is completely outside this overlap region. TCP is given by a logistic function. NTCP is calculated from the Lyman model. A cost function, which is defined as a product of TCP and $1-NTCP$, is calculated. We did detailed analyses by varying the model parameters. For example, a prostate treatment plan with a prescription dose of 80 Gy involves a PTV overlapping with a rectum volume. The analysis indicates that the cost function is the maximum when the constraint dose in the overlap region is 80 % of the prescription dose. The method is applied to other sites for which there is overlap between PTV and critical structures.