

AbstractID: 6883 Title: Automated selection of tradeoff parameters in IMRT prioritized prescription treatment planning

Purpose: Prioritized prescription optimization is a method of IMRT treatment planning which solves the optimization problem step-wise, first by determining the best performance of a high-priority objective and then converting it to a constraint as lower priority goals are optimized in turn. This system is fully automated; however, there is a variable value we call 'slip' factor which determines the amount of degradation allowed after each priority is addressed. The purpose of this work is to investigate an approach to automating selection of the slip factor.

Method and Materials: We propose a new version of prioritized prescription optimization that, after each step, estimates the desired value of the slip factor for the next step. We estimate, to first order, the rate of change of the objective function with respect to small perturbations in the slip. We then apply the Sensitivity Theorem to analyze the effect of the slip factor. In summary, after solving the first problem and obtaining the solution to the first step, \mathbf{w}^1 , we plug the value of \mathbf{w}^1 into a closed-form expression of the Lagrange multiplier vector $\boldsymbol{\lambda}(0)$ to get $\boldsymbol{\lambda}(0)$, and then use the last element of $\boldsymbol{\lambda}(0)$ to compute the first-order approximation model for the optimal objective value with variable slip.

Results: We use the Sensitivity Theorem and Lagrange multipliers to derive a first-order approximation model for the optimal objective function value for a given slip factor. On this basis, we propose to automatically select slip values based on the expected gain in the objective function.

Conclusion: We have developed a mathematical theory and framework which allows us to automate the selection of the slip factor in prioritized prescription optimization, based on a local linear approximation. This proposal is the subject of ongoing tests.