

AbstractID: 5486 Title: Simplifying parameter adjustment for prostate IMRT planning using sensitivity analysis

Purpose:

To simplify the trial-and-error process of adjusting objective function parameters (e.g. weights, dose limits) in prostate IMRT planning, we present a feasibility study showing that an outer loop optimization over 6 automatically-identified sensitive parameters can quickly and automatically determine parameters that lead to a plan meeting the clinical requirements.

Method and Materials:

We apply statistical sensitivity analysis to quantify the effect of each hand-tunable parameter of the IMRT cost function on each clinical objective, automatically identifying those parameters with the strongest impact. Second, we globally optimize a plan quality score over the six most sensitive parameters in an outer loop to determine acceptable parameters, using a search algorithm based on multiscale random sampling.

Results:

Experiments on a 36-patient dataset showed that a clinically acceptable five-field 8640cGy prostate IMRT plan could be automatically determined in 35 minutes on the average in 87% of the cases. Compared to the plans from the planner's protocol default settings, the mean value of the minimum dose in PTV increased from 67.5% to 79.7%, and the mean value of PTV V95 coverage increased from 82.2% to 94.1%. The mean values of rectal wall V54%, rectal wall V87% and bladder wall V54% are 50.4%, 12.6% and 36.1%, respectively. The outer-loop-optimized plans met DVH constraints defining clinical acceptability and were comparable to manually-determined plans. Confining the parameter search to the sensitive parameter set greatly improves the quality and speed of the outer-loop optimization.

Conclusion:

The reduced-order outer-loop optimization can facilitate parameter selection for dose-volume-based IMRT objectives. It may also be applicable to other types of objective functions, and has the potential to ease the manual burden of IMRT planning in more complex sites (e.g. head and neck).

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