Purpose: The spatial distribution of radiation dose within the PTV does have clinical significance. For instance, if hot/cold spots in the PTV cannot be avoided, high doses are preferred to be located in the center, and low doses at the peripheries. However, traditional plan optimization models for IMRT usually treat equally voxels inside the same structure, failing to incorporate those location preferences. We present a re-optimization model that, while preserving the quality of an initial treatment plan represented by DVH curves, incorporates spatial information for voxels inside the PTV into the optimization to generate a more desirable dose distribution.

Methods: Our re-optimization model incorporates a convex function that penalizes the deviation of the dose received by each voxel from an individual reference value. For PTV, the reference values per voxel match the ideal redistribution of the initial PTV dose, where voxels close to the boundary receive the low doses, while voxels in the center receive the high doses. For OAR, the reference value per voxel corresponds to its dose from the initial plan. In addition to the structure-based weighting factors in traditional planning approaches, we incorporated individual penalty weights for PTV voxels. Structure-based factors are calibrated according to the difference from the reference DVH curves, while voxel-based, according to the difference to reference value.

Results: We tested our model in four gynecologic cancer cases. For each case, we compare the resulting dose distribution within the PTV to that from the initial plan. It is observed that without sacrificing the plan quality represented by DVH curves, our re-optimization model generates more desirable PTV dose distributions.

Conclusions: We have presented a re-optimization model that, by incorporating spatial location information for PTV voxels, yields to more clinically favorable dose distributions with similar DVH curves.

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