AbstractID: 13420 Title: Reduced Order Constrained Optimization (ROCO): Clinical Application to Lung IMRT

Purpose: Traditional IMRT optimization, which minimizes a score function expressing dosimetric objectives for the target and normal tissues, often requires many time-consuming adjustment-reoptimization cycles. ROCO allows planners to produce clinically acceptable plans in a shorter time by directly specifying hard constraints on the treatment plan, rather than score function terms. We show that ROCO plan quality can equal or surpass clinical plans from experienced planners in complex cases with patient-specific beam and anatomical geometries.
Method and Materials: We used the images and beam directions from the clinical plans of 11 locally-advanced lung cancer patients. ROCO starts by choosing random sets of score function parameters via latin hypercube sampling, and optimizing these plans. PCA subsequently isolates the important modes of variation in the intensity matrices, which shifts the independent variables of the problem to 25 PCA modes. Sampling and PCA modes are generated for each patient individually, not as class solutions. The final step is hard constraint solution. Dimensional reduction by PCA makes it feasible to rapidly locate clinically acceptable PTV coverage and normal tissue protection in the space spanned by the sampled plans.
Results: The ROCO plans were evaluated by an experienced treatment planner to confirm clinical acceptability. When normalized to the clinical plan's PTV D_{95}, they achieved similar normal tissue sparing with deliverable leaf motions; median doses to organs were within 1% of clinical plans. In total, a ROCO plan was produced in approximately 30 minutes (unsupervised), whereas the average time required for a clinical plan is 45-75 minutes with continual supervision.
Conclusion: Dimensionality reduction via PCA allows direct and efficient hard constraint solution of the IMRT problem for complex lung cancer cases. Preliminary results show that ROCO can achieve an acceptable, and sometimes superior, plan in reduced time.
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