Computational Boundary Sampling to Accelerate IMRT optimization

We show below the results of our prioritized programming approach on two head & neck cases for three different scenarios:

1) No Sampling (NS): all voxels were considered for optimization.
2) Computational boundary sampling (CBS): the boundary voxels and 10% of inner voxels, selected using grid sampling, were considered for optimization.
3) Random Sampling (RS): 15% of voxels in each organ were randomly selected.

**Dose quality on targets: CBS = NS > RS**
Next two figures show the D95 comparison of targets. D95 given by CBS is close to that of NS with difference within 1%. But RS is 3%-4% worse in terms of D95.

**Standard deviation: CBS << RS**
We made 5 runs of CBS and RS since they are random algorithms. The standard deviation of D95 for target 1, MOH5 (mean of hottest 5%) of Brain, and mean of Brainstem are compared. They are normalized so that the values of CBS are always 1. RS has much larger standard deviation, showing that CBS is not only better, but also more consistent.
**Dose quality on sensitive and other organs: CBS ≈ NS**

Brainstem is the sensitive organ in these two cases. We compare the MOH5 of brainstem from NS and CBS. We also compare the mean dose of Brain and Cord. We can see that CBS actually attains lower dose than NS in most of these organs, except for the mean of brain in Case 1.

![Brainstem MOH5 Chart](chart1)

**Time and memory requirements: CBS << NS**

Our last result shows that the time and memory costs are greatly reduced by CBS compared to NS. In conclusion, CBS attains comparable dose quality as NS using dramatically less time and memory.

![Memory (GB) Comparison Chart](chart2)

![Time (hour) Comparison Chart](chart3)