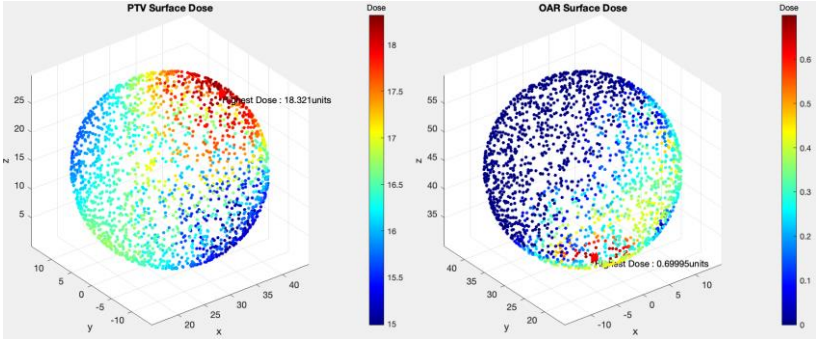
CISC 330 Assignment 4 Discussion

Compute Surface Dose in PTV and OAR

We observe a heterogenous dose distribution across the surface of PTV where the highest recorded dose is 18.321, in the epicenter of the red part of the 'heat map' ensuring concentrated irradiation at the isocenter, whereas the OAR heat map shows a relatively more homogenous dose distribution indicating lower absorption of radiation which peaks at 0.6995 which is desirable as it minimizes the risk of radiation induced damage to the organ. This helps us achieve maximized tumour control probability by delivering adequate doses to the PTV while minimizing the risk of complications by sparing the OAR from excessive radiation.



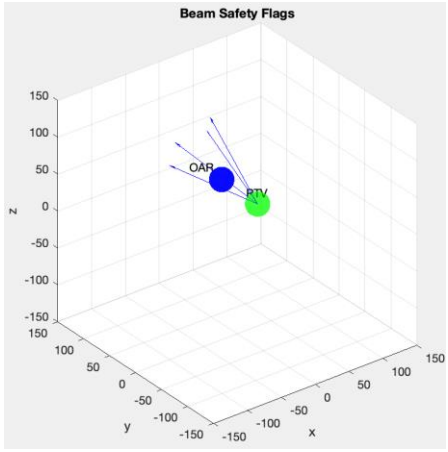
Compute Optimal Irradiation Time

Underestimated Isocenter Treatment Dose when all "safe" beams are on, and the overestimated OAR dose can give us a good idea of the potential amount of time we can provide the most dose volume without damaging the organ.

There are 34 possible beams with defined 30 degree angle separation between them, using this, the average distance between the head and isocenter, the minimum possible skin depth to isocenter, we can estimate the dose using the Dose Absorption Table to be around ~0.80 units which is shown to be accurate in the program. This dose multiplied by the number of beams gives us a min dose of 29.6 units.

Using the distance between the head and the OAR center and the isocenter, and the angle between the 4 "unsafe beams" that intersect with the OAR (60 degrees), the max possible skin depth into OAR within a 7.5mm radial distance (threshold for 1 unit dose). The Dose Absorption Table estimates it to be around 0.90 unit dose, doing the multiplication as before we get 3.6 units.

Since D100 is 20 units and DOARMAX is 10 units, these estimates suggest a suitable setup the min possible dose to the PTV is 29.6 which is higher than the threshold required, while max possible dose to OAR is 3.6 which is much lower than its threshold. This checks out in the programs as well as we found the isocenter dose to be around 27 units and max OAR dose to be around 0.9 units.



This would mean that the nominal treatment time of 10 minutes would be good enough to provide optimal therapeutic radiation to the PTV while minimizing damage to the OAR.

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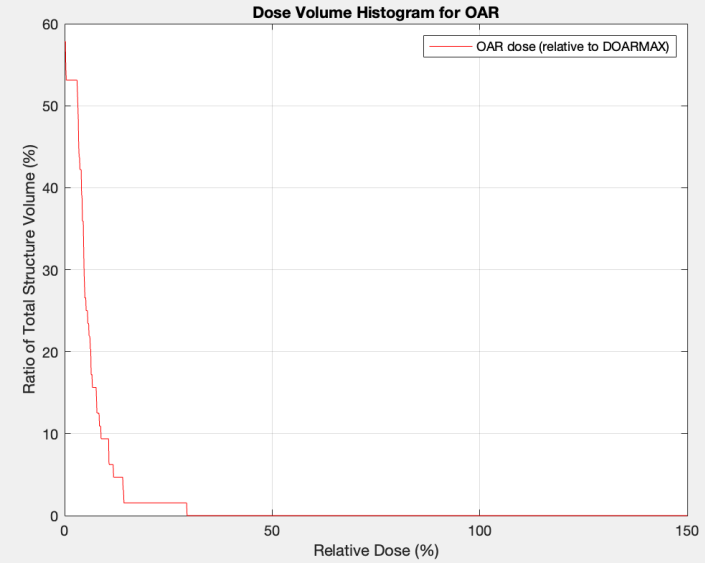

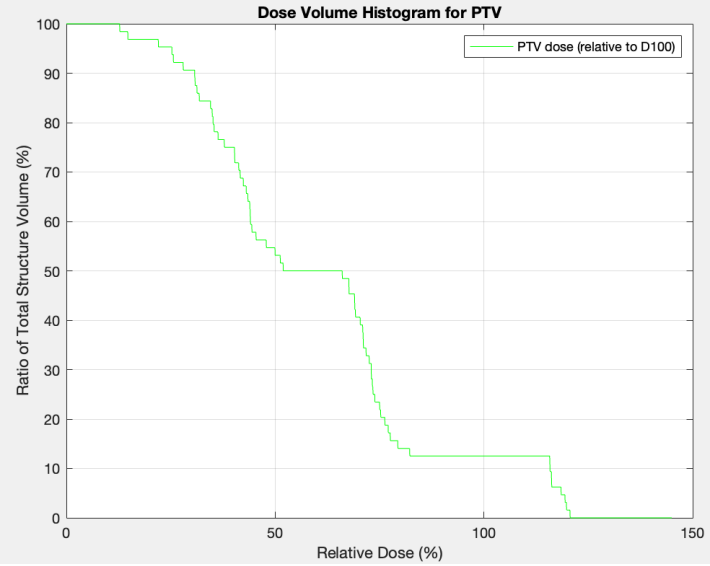

These dose-volume histograms (DVHs) show the dose distribution within the PTV and OAR.

The DVH for the OAR receives a tiny dose which is our aim as we want to minimize damage. Here, majority of the OAR receives < 10% of DOARMAX, which shows the effectiveness of the treatment setup.

The DVH for the PTV shows gradual decline while showing a major percentage of it receiving a high dose, which while close to the ideal isn't really as we would prefer to see it to D100. This may suggest our treatment setup could be optimised further to 'push' our PTV DVH to the 'top' and the OAR DVH to the 'bottom'. We could do this by optimising beam angles perhaps, or maybe modulating the intensity of radiation beams more precisely.