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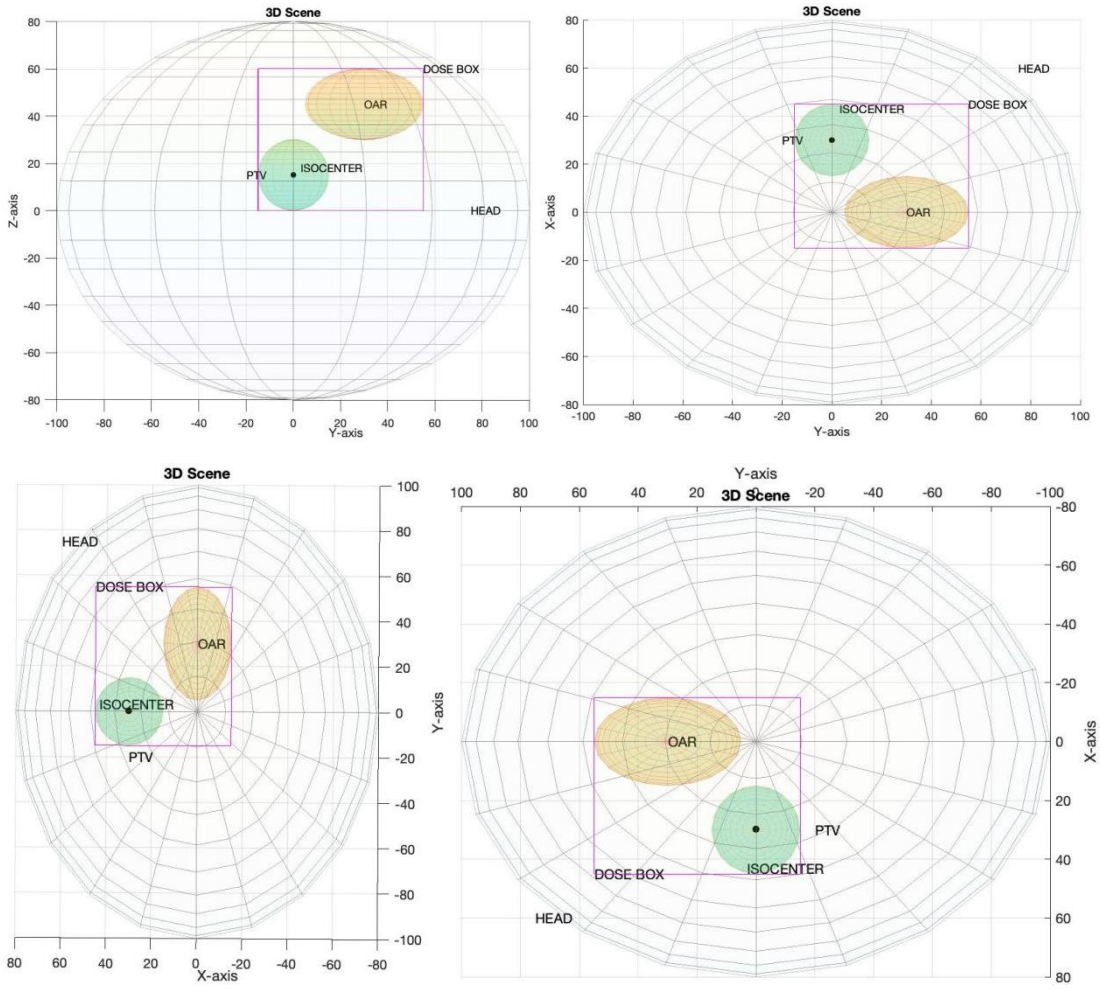
A4 Paper Work

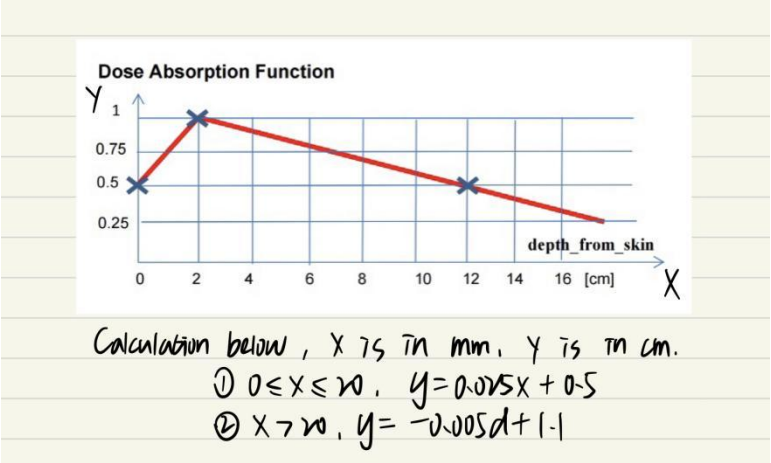
1. Draw_3D_Scene

I used a function Compute_Dose_Box.m to compute the dose box.

Below are some representative views to show that the dose box properly covers the PTV and OAR:



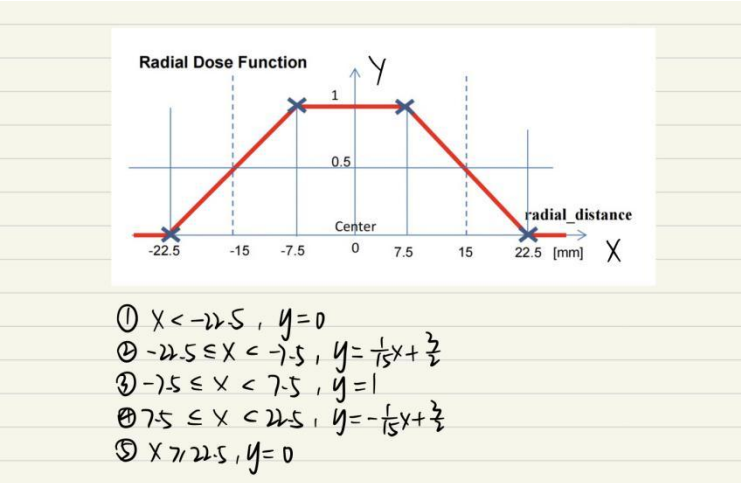
2. Compute Dose Absorption Function Table



It's part of the table generated, which includes three key points - (0, 0.5), (20, 1), (120, 0.5).

0.0000	0.5000	104.0000	0.5800
1.0000	0.5250	105.0000	0.5750
2.0000	0.5500	106.0000	0.5700
3.0000	0.5750	107.0000	0.5650
4.0000	0.6000	108.0000	0.5600
5.0000	0.6250	109.0000	0.5550
6.0000	0.6500	110.0000	0.5500
7.0000	0.6750	111.0000	0.5450
8.0000	0.7000	112.0000	0.5400
9.0000	0.7250	113.0000	0.5350
10.0000	0.7500	114.0000	0.5300
11.0000	0.7750	115.0000	0.5250
12.0000	0.8000	116.0000	0.5200
13.0000	0.8250	117.0000	0.5150
14.0000	0.8500	118.0000	0.5100
15.0000	0.8750	119.0000	0.5050
16.0000	0.9000	120.0000	0.5000
17.0000	0.9250	121.0000	0.4950
18.0000	0.9500	122.0000	0.4900
19.0000	0.9750	123.0000	0.4850
20.0000	1.0000	124.0000	0.4800
21.0000	0.9950	125.0000	0.4750
22.0000	0.9900	126.0000	0.4700
23.0000	0.9850	127.0000	0.4650
24.0000	0.9800	128.0000	0.4600
25.0000	0.9750	129.0000	0.4550
26.0000	0.9700	130.0000	0.4500
27.0000	0.9650	131.0000	0.4450
28.0000	0.9600	132.0000	0.4400
29.0000	0.9550	133.0000	0.4350

3. Compute Radial Dose Function Table



① $X < -22.5$, $y = 0$
② $-22.5 \le X < -7.5$, $y = \frac{1}{15}X + \frac{3}{2}$
③ $-7.5 \le X < 7.5$, $y = 1$
④ $7.5 \le X < 22.5$, $y = -\frac{1}{15}X + \frac{3}{2}$
⑤ $X \ge 22.5$, $y = 0$

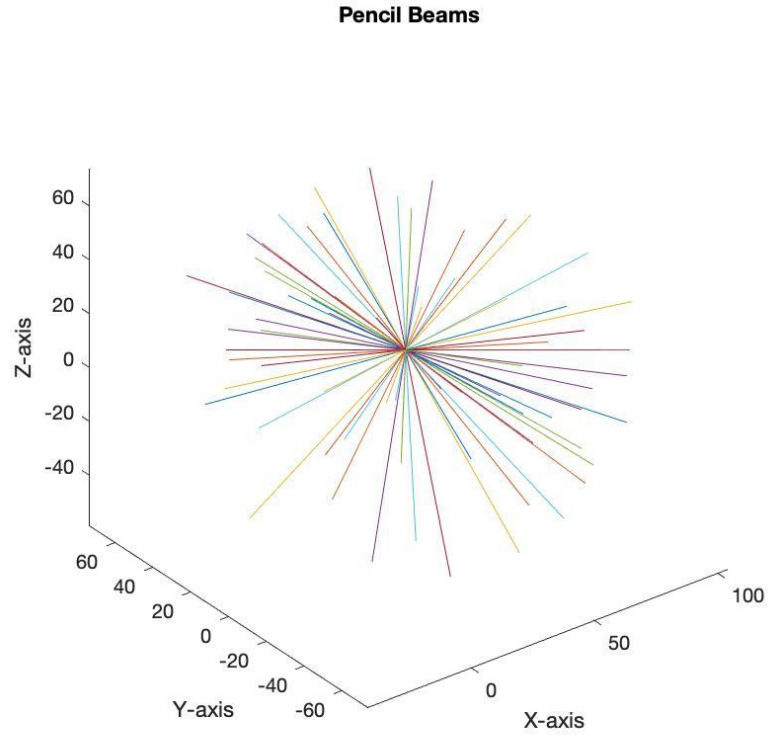
The table is shown as below:

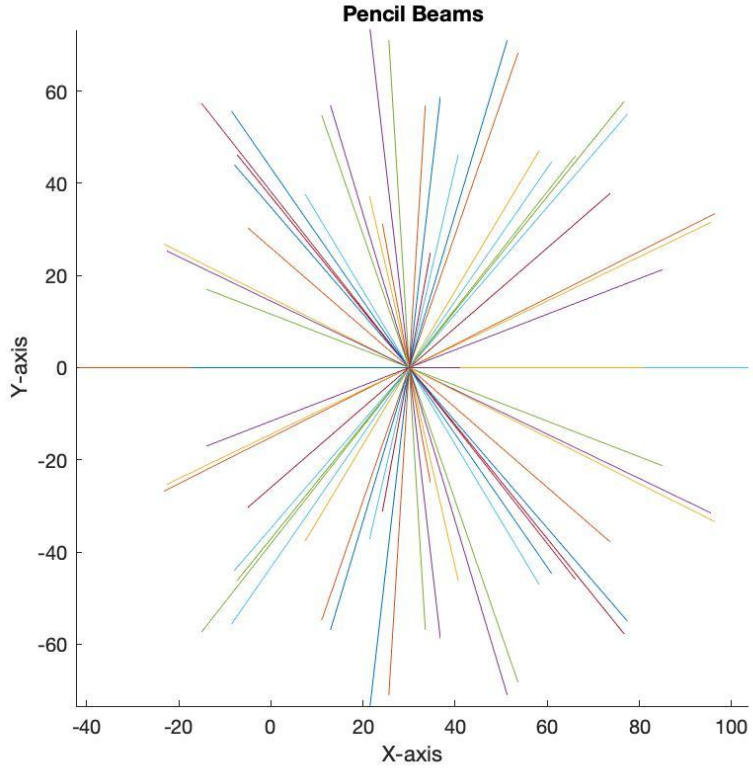
-23.0000	0
-22.0000	0.0333
-21.0000	0.1000
-20.0000	0.1667
-19.0000	0.2333
-18.0000	0.3000
-17.0000	0.3667
-16.0000	0.4333
-15.0000	0.5000
-14.0000	0.5667

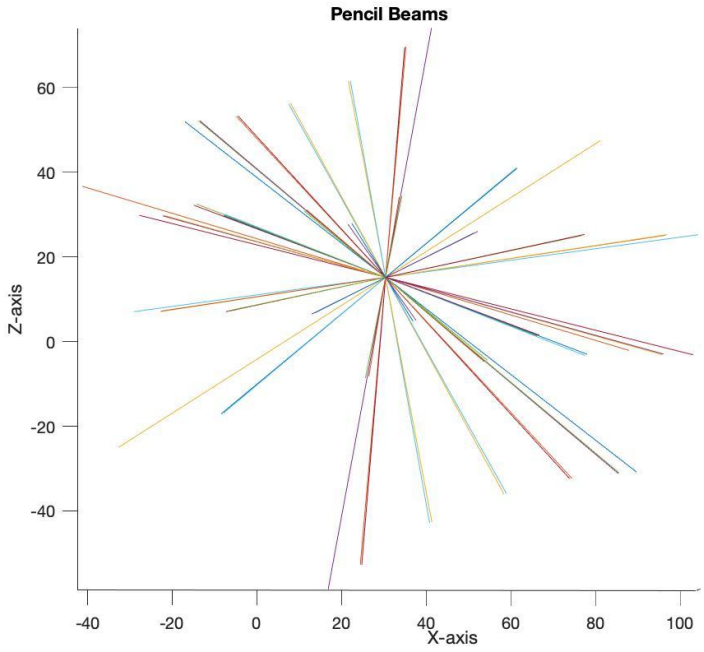
-13.0000	0.6333
-12.0000	0.7000
-11.0000	0.7667
-10.0000	0.8333
-9.0000	0.9000
-8.0000	0.9667
-7.0000	1.0000
-6.0000	1.0000
-5.0000	1.0000
-4.0000	1.0000
-3.0000	1.0000
-2.0000	1.0000
-1.0000	1.0000
0	1.0000
1.0000	1.0000
2.0000	1.0000
3.0000	1.0000
4.0000	1.0000
5.0000	1.0000
6.0000	1.0000
7.0000	1.0000
8.0000	0.9667
9.0000	0.9000
10.0000	0.8333
11.0000	0.7667
12.0000	0.7000
13.0000	0.6333
14.0000	0.5667
15.0000	0.5000
16.0000	0.4333
17.0000	0.3667
18.0000	0.3000
19.0000	0.2333
20.0000	0.1667
21.0000	0.1000
22.0000	0.0333
23.0000	0

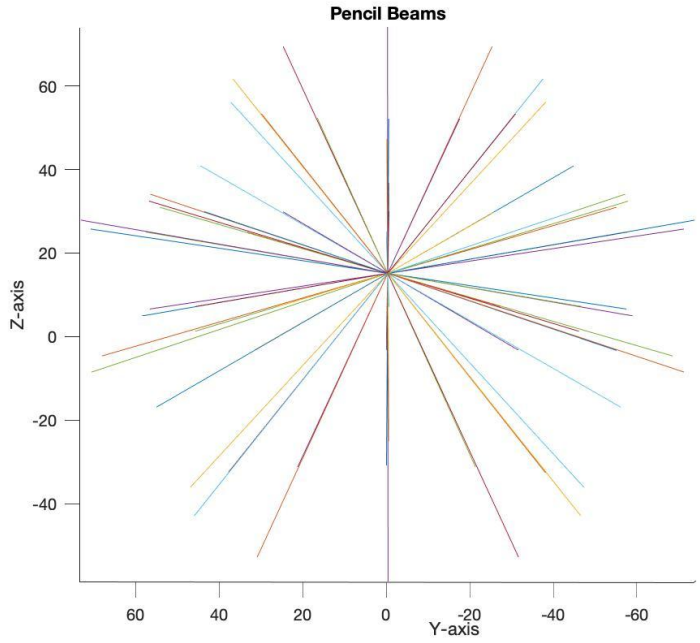
4. Compute Beam Directions

Below are some representative views.


Pencil Beams
Z-axis
60
40
20
0
-20
-40
Y-axis
60
40
20
0
-20
-40
-60
X-axis
100
50
0

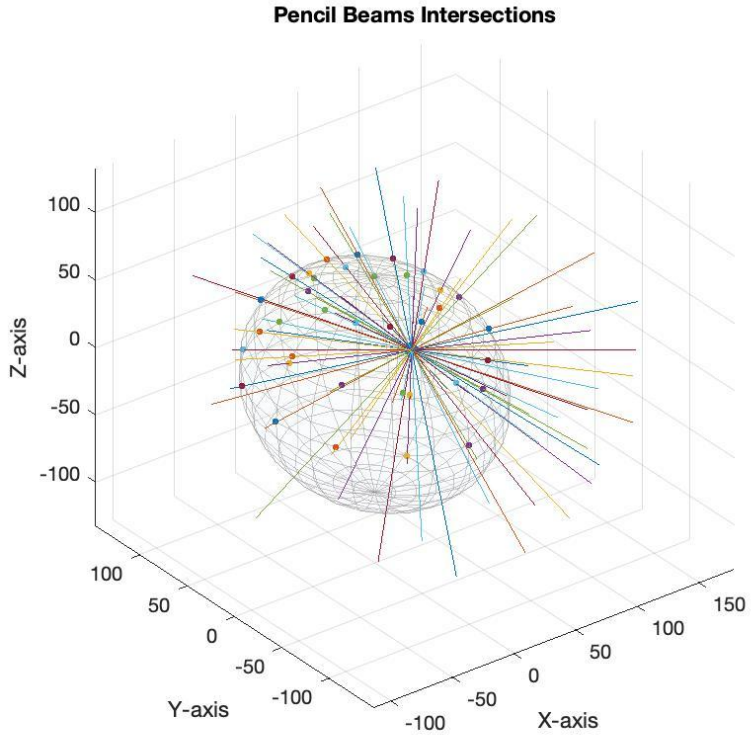

Pencil Beams
Y-axis
60
40
20
0
-20
-40
-60
X-axis
-40
-20
0
20
40
60
80
100

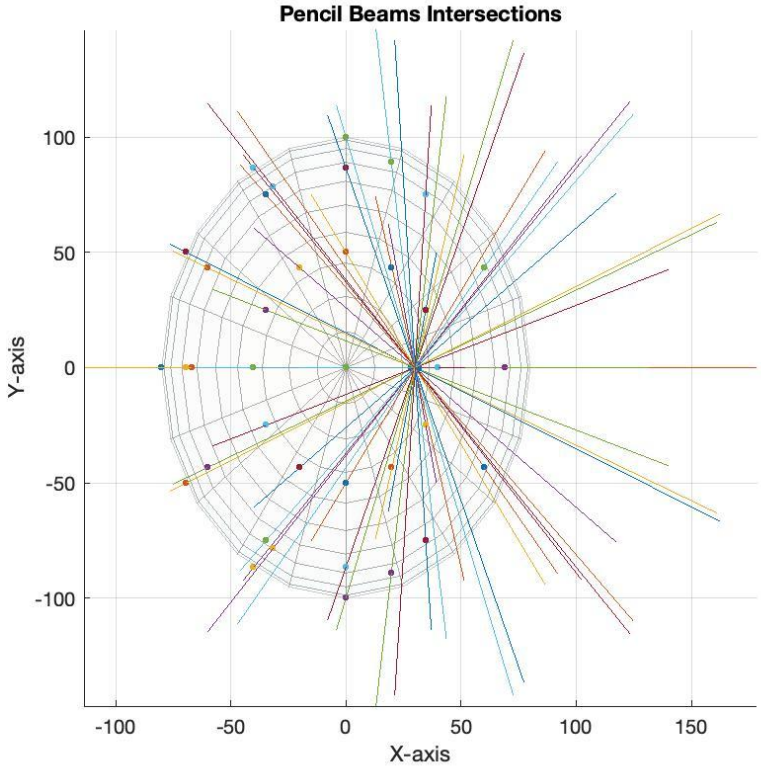




5. Compute Skin Entry Points

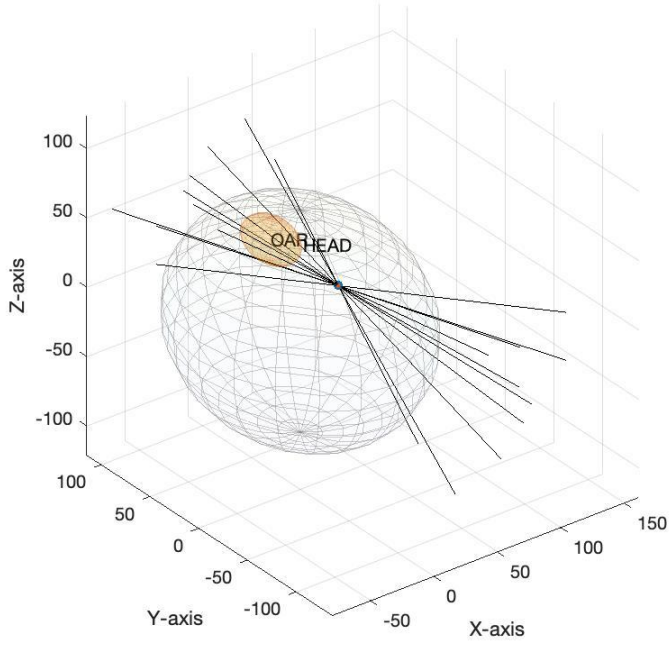
Below are some representative views.





6. Compute Beam Safety Flags

I didn't figure out how to plot a rotated cylinder therefore I only plotted the directional vectors of unsafe beams.



7. Compute Radial Distance

The result is shown as below:

```
The radial distance should be 15, and it is: 15
```

8. Compute Depth From Skin

The result is shown as below:

```
The radial distance should be 71.5891, and it is: 71.5891
```

9. Compute Point Dose From Beam

The result is shown as below:

```
The point dose value is equal to the DAF value for all the beam.
Test passed!
```

10. Compute Point Dose From All Beams

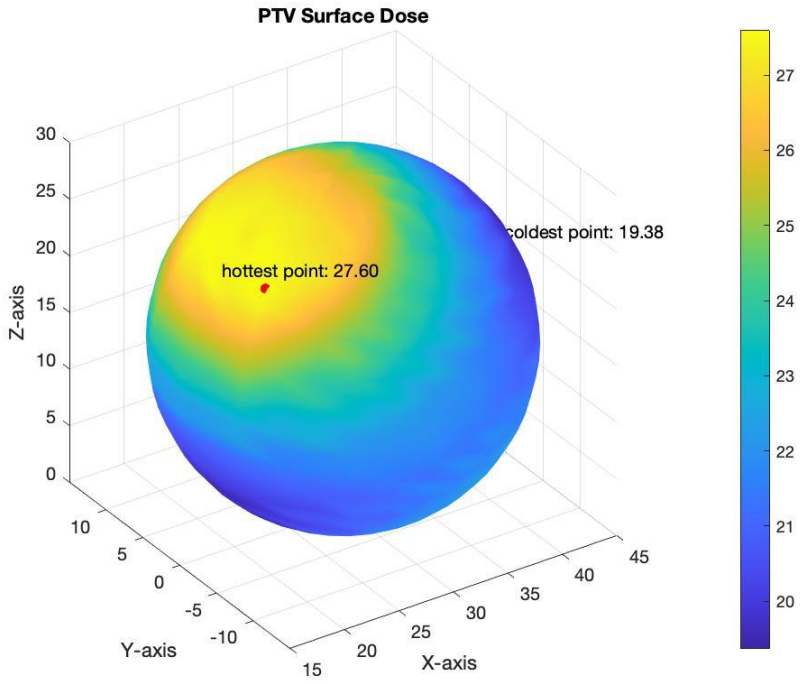
The result is shown as below:

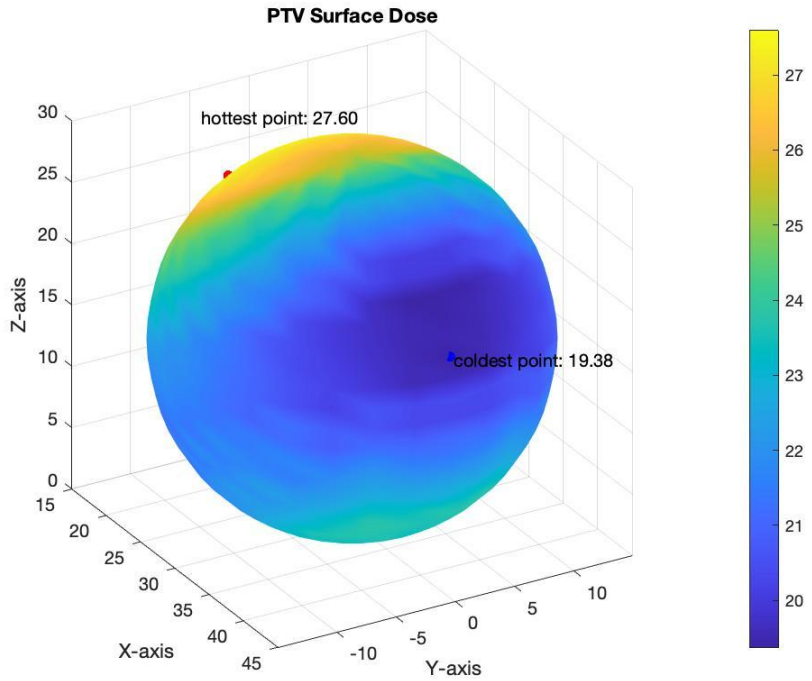
```
These two results are equal.
Test passed!
```

11. Compute Surface Dose on PTV

The result of printing and plot is shown as below:

```
The hottest point is at [20 -5 25] and receives dose of 27.60.
The coldest point is at [44 0 20] and receives dose of 19.38.
```



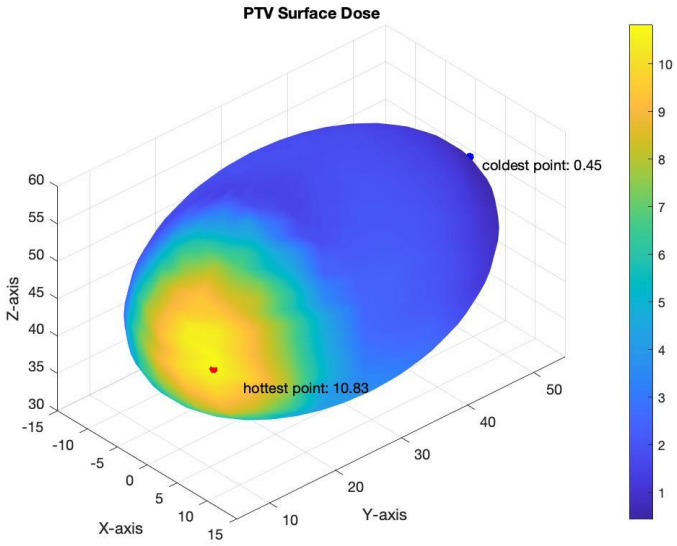


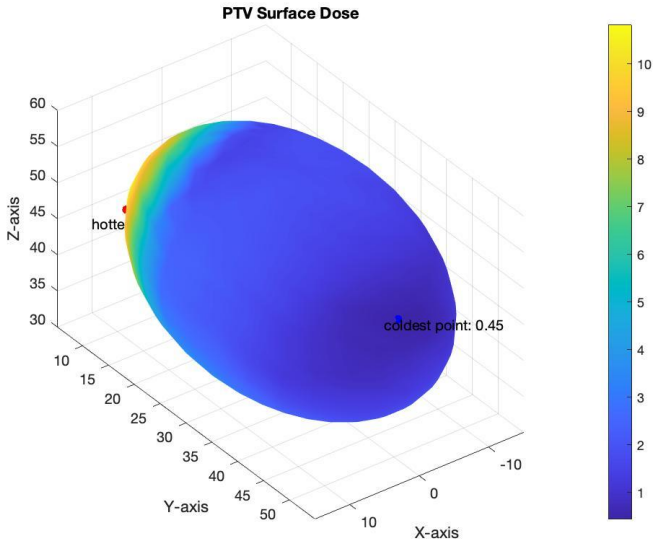
The PTV Surface Dose is explained as below:
It is obvious that the majority part of this diagram is in cold(blue) color, only a small part is in hot(yellow or green) color, which means most of PTV surface will receive less dose relative. However, relative to OAR Surface Dose, the dose that can be received is still more since even at

the coldest point, it still can receive a dose of 19.38.
But this is consistent with common sense, as PTV deserves to receive more doses.

12. Compute Surface Dose on OAR
The plot is shown as below:

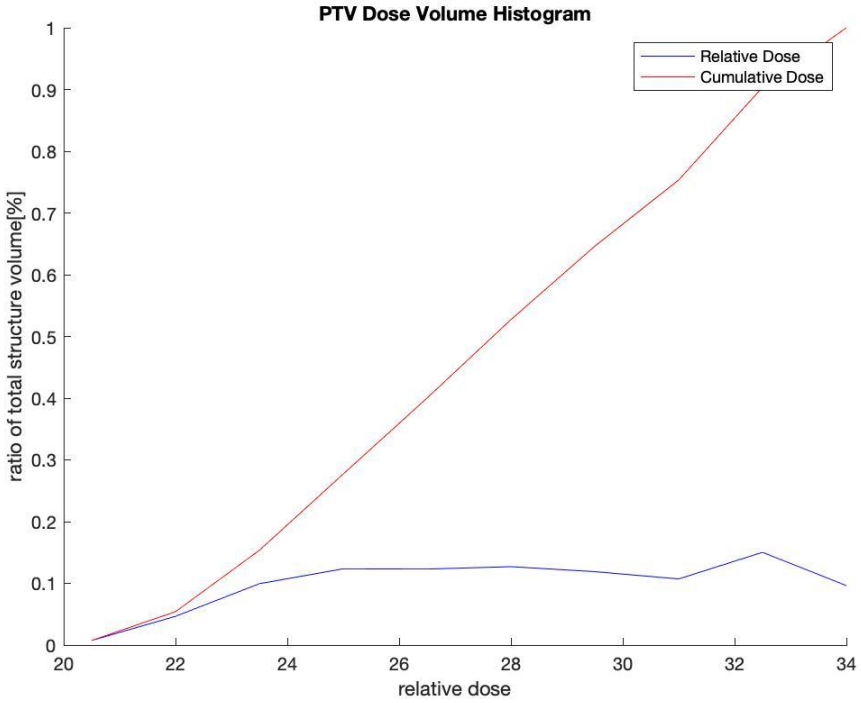
```
The hottest point is at [8 8 45] and receives dose of 10.83.
The coldest point is at [1 53 51] and receives dose of 0.45.
```





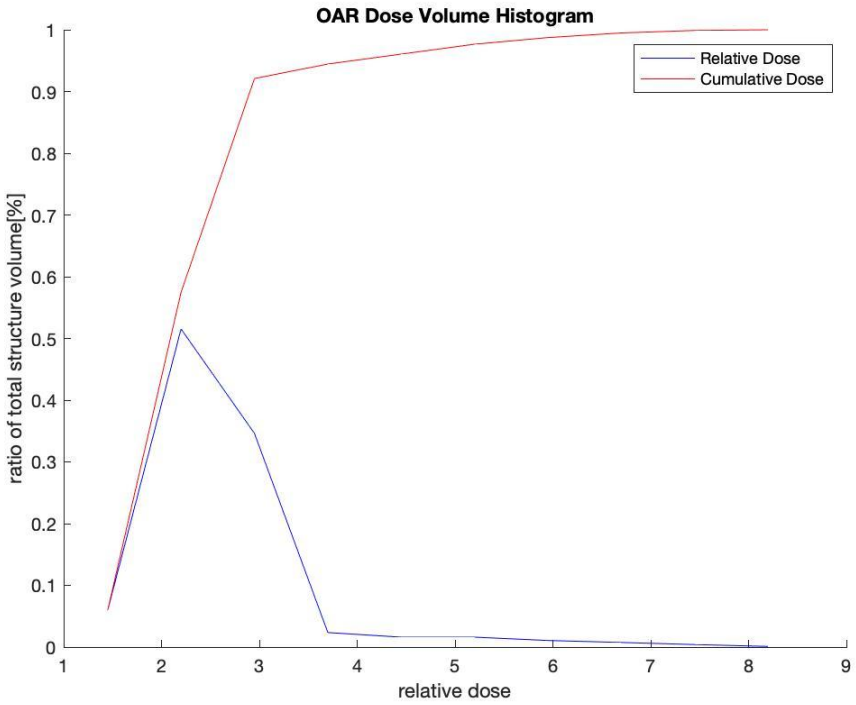
The OAR Surface Dose is explained as below:
It is a case which is similar to PVT Surface Dose. We can obviously see that the most of OAR Surface Dose is in cold(blue) color, whereas only a small part is in yellow or green color, which means most of OAR surface can receive little or even no dose since at the coldest point, it only receive a dose of 0.45.
Therefore I could say the result is good since we shouldn't let OAR receive too much dose.

13. Compute Volume Dose in PTV:



The PTV Dose Volume Histogram is explained below:
To be able to see the relationship between “relative dose” and “relative volume” more visually, I used two curves - one is curve for relative dose itself, another one is curve for cumulative dose. First of all, for “Cumulative Dose Curve”, as “relative dose” increases, the “relative volume” also increases smoothly. For “Relative Dose Curve”, “relative dose” first starts to rise slowly, then stays steady, then suddenly rises slightly at about Relative Dose = 31, and finally relative volume accumulates to 100% at Relative Dose = 34.

14. Compute Volume Dose in OAR:



The PTV Dose Volume Histogram is explained below:
To be able to see the relationship between “relative dose” and “relative volume” more visually, I used two curves - one is curve for relative dose itself, another one is curve for cumulative dose. For “Relative Dose Curve”, when Relative Dose < 2.2(roughly), relative volume increases fast, after this inflection point, relative volume rapidly decreases again. Then at around Relative Dose = 3.6, the value of relative volume stays very low and then slowly decreases. Corresponding to “Cumulative Dose Curve”, cumulative dose keeps growing rapidly until Relative Dose = 3, after that, cumulative dose keeps growing steadily.