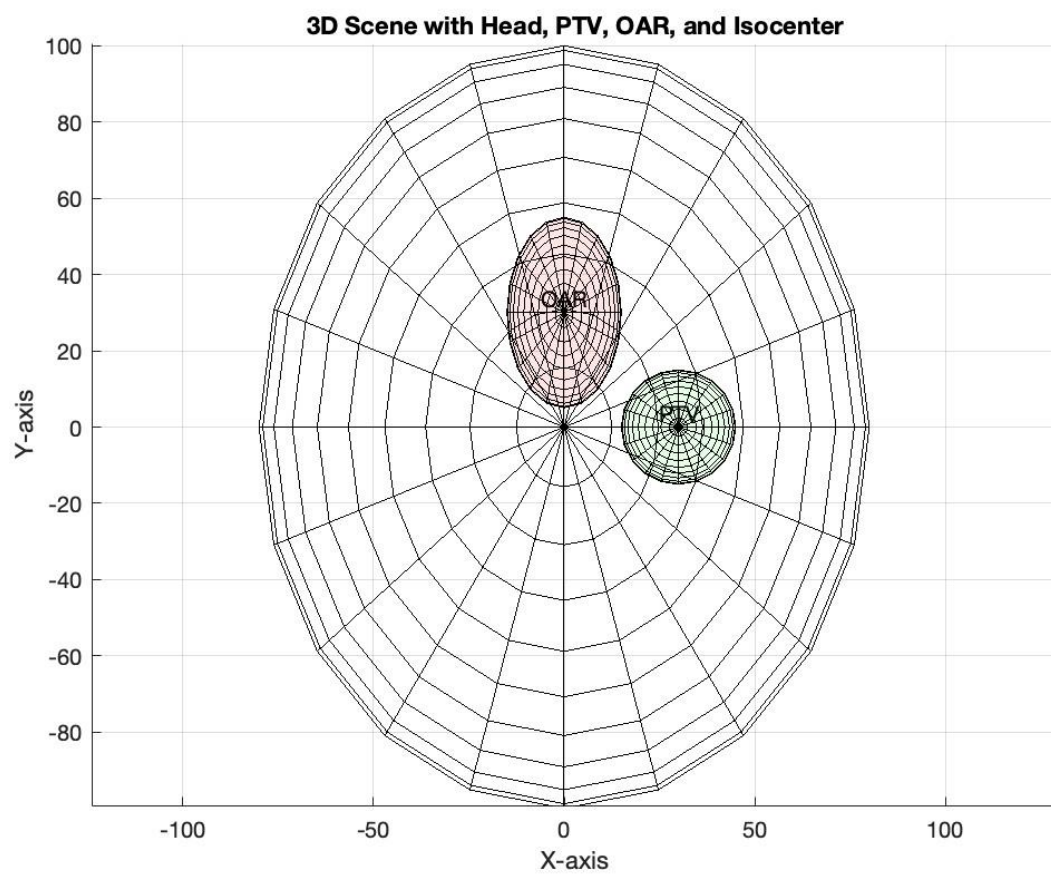
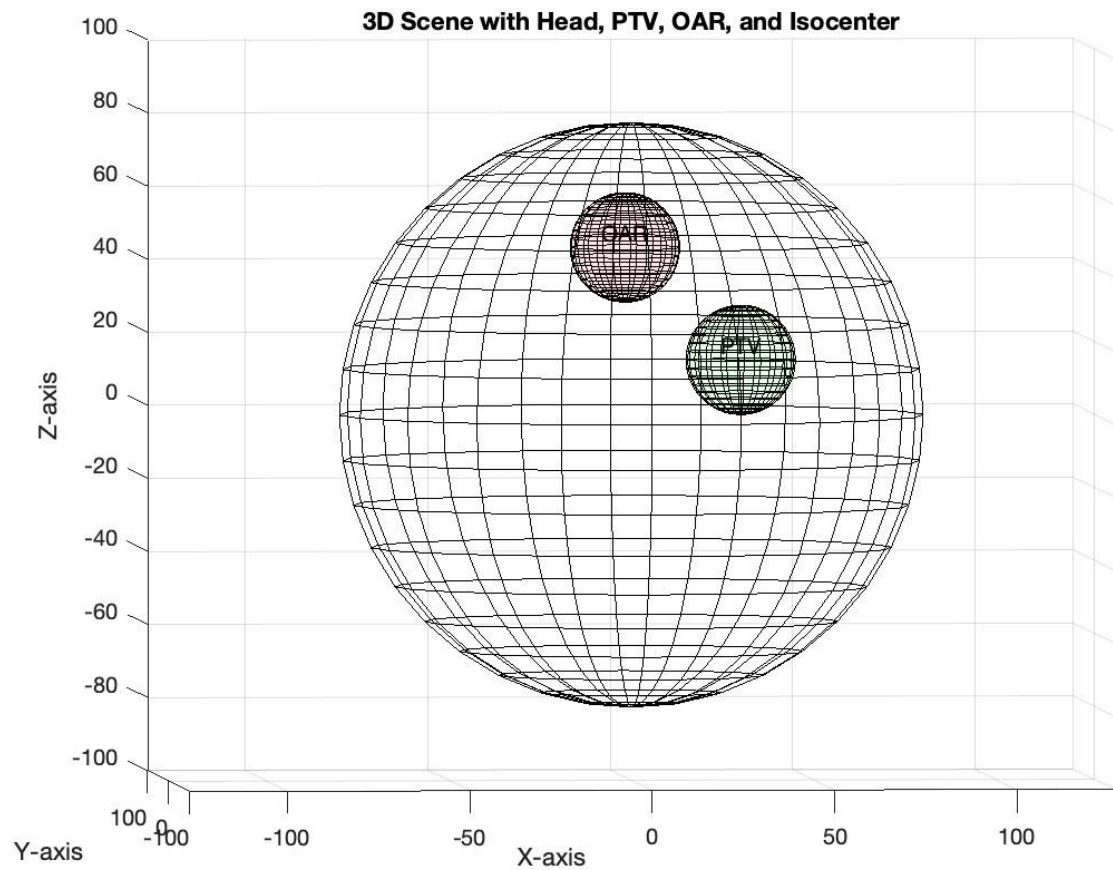


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1. Draw 3D Scene

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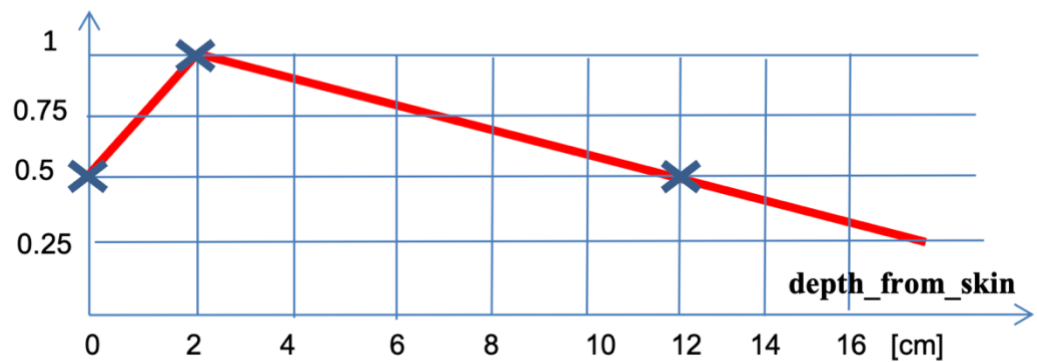




2. Compute Dose Absorption Function Table

We can see that the output of the function is at 1 when the input is 20 as seen in the provided graph and then continues to decay according to the linear function.

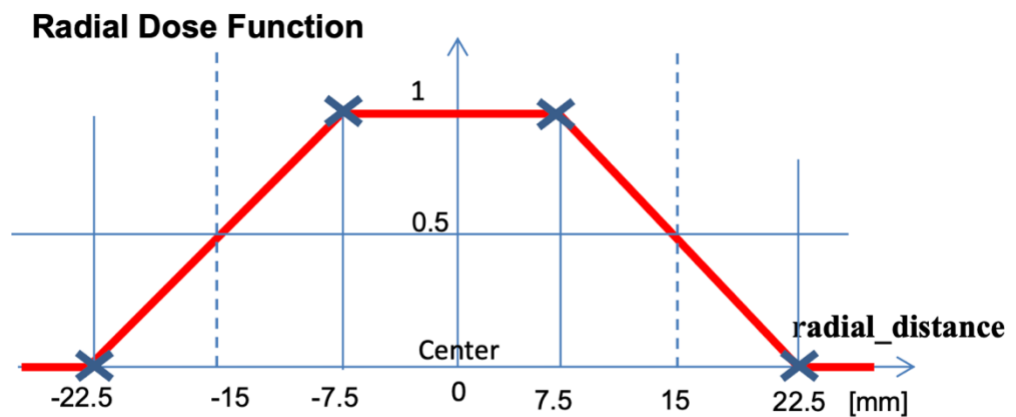
Dose Absorption Function



```
>> test_Compute_Depth_Dose
0      0.5000
```

1.0000	0.5250
2.0000	0.5500
3.0000	1.0850
4.0000	1.0800
5.0000	1.0750
6.0000	1.0700
7.0000	1.0650
8.0000	1.0600
9.0000	1.0550
10.0000	1.0500
11.0000	1.0450
12.0000	1.0400
13.0000	1.0350
14.0000	1.0300
15.0000	1.0250
16.0000	1.0200
17.0000	1.0150
18.0000	1.0100
19.0000	1.0050
20.0000	1.0000
.	.
.	.
118.0000	0.5100
119.0000	0.5050
120.0000	0.5000
121.0000	0.4950
122.0000	0.4900
123.0000	0.4850
124.0000	0.4800
125.0000	0.4750

3. Compute Radial Dose Function Table

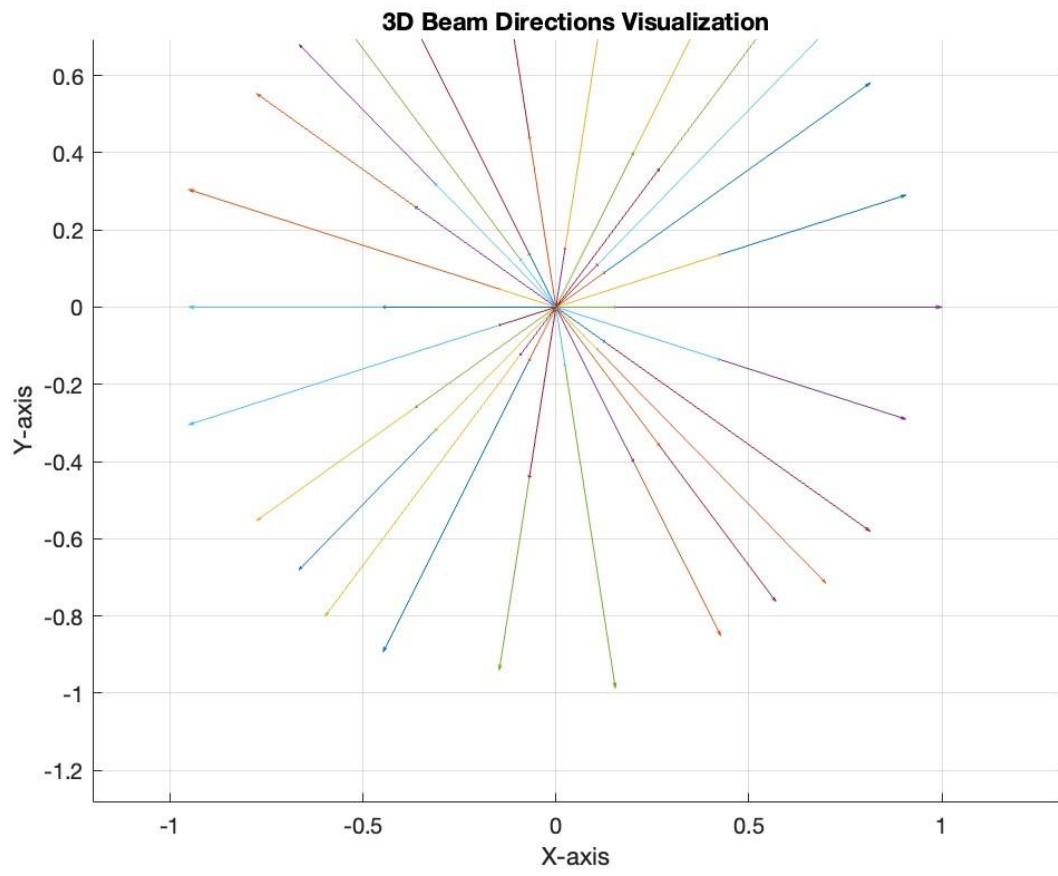


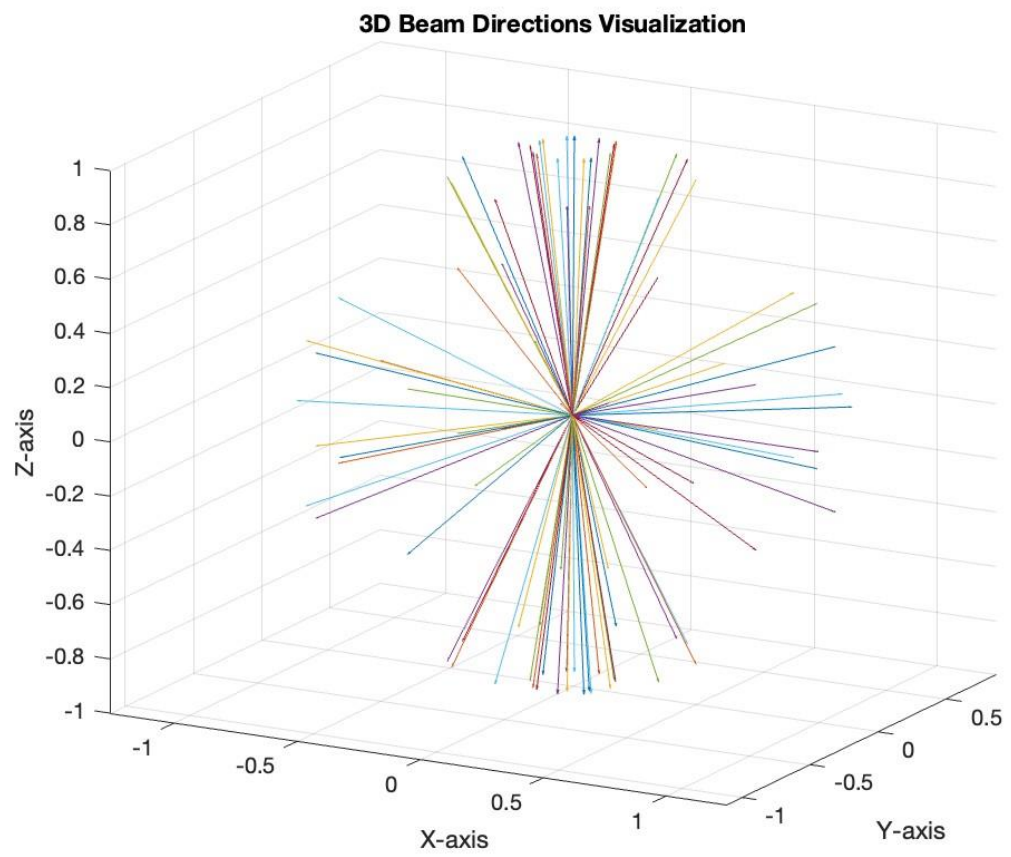
We see that the output follows the graphs shown above. However, the output at $x = 22$ is incorrect since we are using increments of 1

20271708

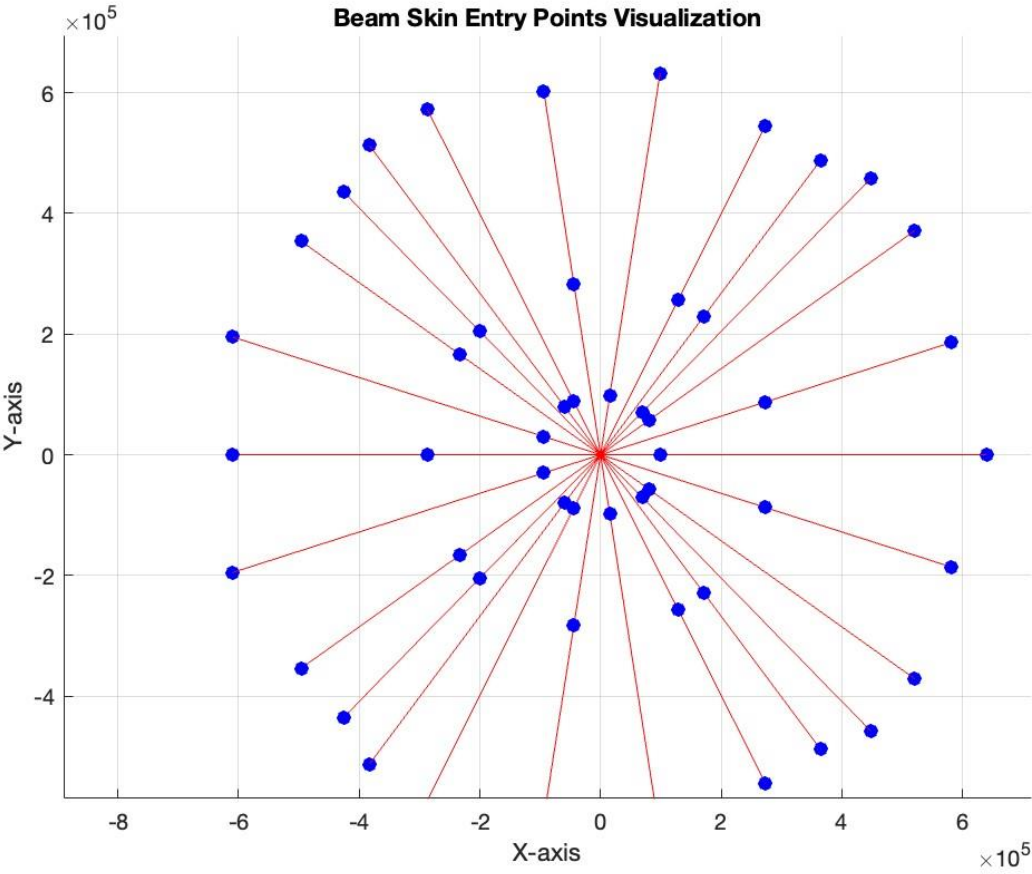
-24.0000	0
-23.0000	0
-22.0000	0.0333
-21.0000	0.1000
-20.0000	0.1667
-19.0000	0.2333
-18.0000	0.3000
-17.0000	0.3667
-16.0000	0.4333
-15.0000	0.5000
-14.0000	0.5667
-13.0000	0.6333
..	..
-4.0000	1.0000
-3.0000	1.0000
-2.0000	1.0000
-1.0000	1.0000
0	1.0000
1.0000	1.0000
2.0000	1.0000
3.0000	1.0000
4.0000	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

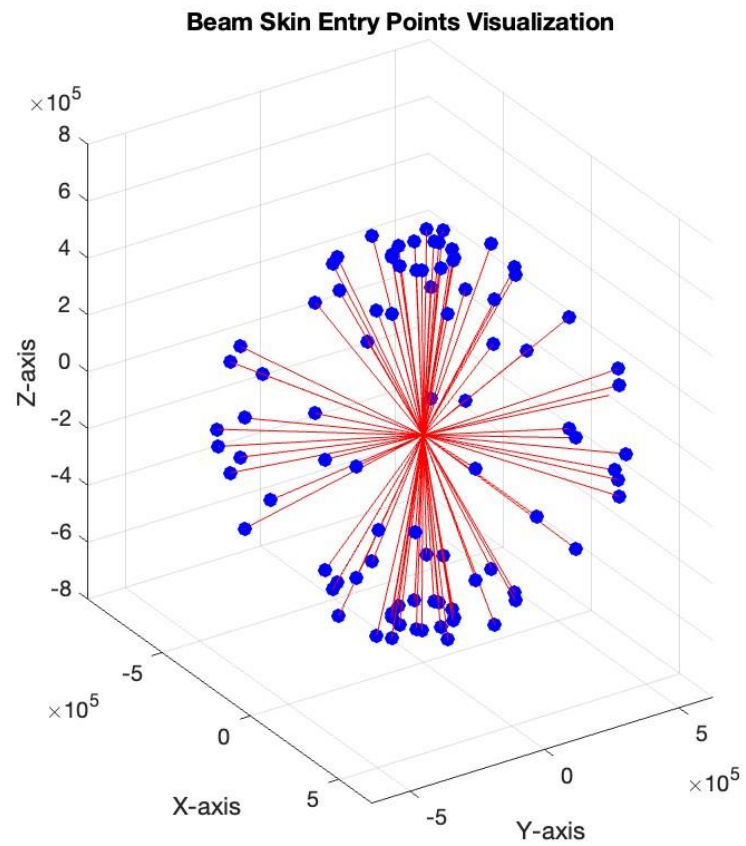
4. Compute Beam Directions





5. Compute Skin Entry Points





6. Compute Beam Safety Flags
7. Compute Radial Distance
8. Compute Depth from Skin
9. Compute Point Dose from Beam
10. Compute Point Dose from all Beams
11. Compute Surface Dose on PTV

**You****11. Compute Surface Dose on PTV**

Description: Write a function to compute the dose on the surface of the structure. Plot the result as a colored 3D surface with a color bar showing color scale. Compute the hottest and coldest dose and locations, print these locations and dose values, mark these locations in the surface plots. Analyze your findings with respect to dosimetric objectives.

Name: Compute_Surface_Dose_PTV

Test: None beyond the plots and prints required above.

Hint: Can use surface patching from "sphere" and can use "surf" or "mesh" to plot it, with "colorbar"

how can i approach solving this



To approach solving the task of computing and visualizing the surface dose on a PTV (Planning Target Volume), follow these steps:

1. **Generate Surface Points:** Create a grid of points on the surface of the PTV. This can be done using the `'sphere'` function in MATLAB.
2. **Calculate Dose at Each Point:** For each point on the surface, calculate the radiation dose. This involves summing the doses from all beams at each surface point.
3. **Identify Hottest and Coldest Points:** Determine the points with the maximum and minimum dose values.
4. **Visualize the Dose Distribution:** Plot the PTV with a color-coded surface representing the dose distribution. Use a color map to indicate different dose levels.
5. **Annotate and Save the Plot:** Mark the hottest and coldest points on the plot, add a color bar, and label the axes. Save the plot for further analysis or presentation.

**You**

Identify Hottest and Coldest Points

relative to what Since i assume there will not be a single hottest or coldest value

**final**

Identifying the "hottest" and "coldest" points on the PTV (Planning Target Volume) surface in the context of radiation therapy typically refers to finding the points with the highest and lowest radiation dose values, respectively. Here's how you can approach this:

1. **Understanding Dose Distribution:** After calculating the radiation dose at each point on the PTV's surface, you'll have a set of dose values. These values represent the amount of radiation each point on the surface would receive.
2. **Hottest Point:** This is the point on the PTV surface that receives the maximum dose of radiation. It's the point where the radiation is most intense. Mathematically, it's where the dose value is the highest in your set of calculated doses.
3. **Coldest Point:** Conversely, this is the point on the PTV surface that receives the minimum dose of radiation. It's the point where the radiation is least intense. Mathematically, it's where the dose value is the lowest in your set of calculated doses.
4. **Uniqueness of Points:** While it's possible to have multiple points with the same maximum or minimum dose (especially in symmetrical distributions), typically, you identify the first occurrence of these values. In MATLAB, using ``max`` and ``min`` functions along with ``find`` can help locate these points.



final

The choice of the number of surface points for generating a grid on the PTV (Planning Target Volume) using MATLAB's ``sphere`` function depends on several factors:

1. **Accuracy Required:** A higher number of surface points allows for more accurate calculations of dose distribution. If precise mapping of dose variations is essential, a denser grid (higher number of points) is preferred.
2. **Computational Resources:** More surface points mean more calculations, which increases computational load. If computational resources are limited, you might need to opt for a lower number of points.
3. **Size and Complexity of the PTV:** For larger or more irregularly shaped PTVs, a higher number of points might be necessary to accurately capture the dose distribution. For smaller or more regular shapes, fewer points may suffice.
4. **Purpose of the Analysis:** For detailed research or critical clinical evaluations, a higher resolution (more points) is usually necessary. However, for preliminary analysis or scenarios where a general overview is sufficient, fewer points might be adequate.

For example, a value of ``30`` is often a practical choice for many applications, providing a balance between surface detail and computational demands. However, the best choice for your specific case will depend on the factors mentioned above.

12. Compute Surface Dose on OAR
13. Compute Optimal Irradiation Time
14. Compute Volume Dose in PTV

**You****14. Compute Volume Dose in PTV**

Description: Write a function to compute the dose inside the structure using a uniform cartesian grid box placed

around the structure. (To speed up development, you can use a coarse grid, in the final analysis try to use 1.0

mm grid size.) To analyze dose coverage, compute and plot the cumulative dose volume histogram as you

learned in class. Evaluate and explain your findings with respect to clinical dosimetric objectives. Explain if/how

you can improve on the dosimetric outcome.

Name: `Compute_Volume_Dose_PTV`

Test: None beyond the plots and prints required above.

Hint: You could start from the centre of the organ and step outward on the grid. You could use "[N,edges] =

histcounts(X,edges)" function (see <https://www.mathworks.com/help/matlab/ref/histcounts.html>) to generate

the data points for the cumulative dose volume histogram.

what steps to implement this

**final**

To implement the '`Compute_Volume_Dose_PTV`' function, you'll need to create a grid around the PTV (Planning Target Volume), compute the dose at each point in the grid, and then analyze the distribution of these dose values. Here's a step-by-step approach to achieve this:

1. **Create a Grid Around the PTV:** Generate a uniform Cartesian grid around the PTV. The grid should cover the entire volume of the PTV.
2. **Compute Dose at Each Grid Point:** For each point in the grid, calculate the dose received. This will involve summing the contributions from all beams impacting that point.
3. **Analyze Dose Distribution:** Using the computed doses, analyze the distribution within the PTV. This can involve calculating the cumulative dose volume histogram (DVH) to see how the dose is distributed throughout the volume.
4. **Plot and Evaluate:** Plot the DVH and other relevant graphs to visualize the dose distribution. Evaluate these plots against clinical dosimetric objectives.



You

Create a Grid Around the PTV: Generate a uniform Cartesian grid around the PTV. The grid should cover the entire volume of the PTV.

how can i generate this? what steps should i take



final

To create a uniform Cartesian grid around the PTV (Planning Target Volume), you need to follow these steps:

1. **Define Grid Dimensions and Resolution:** Determine the size of the grid based on the PTV dimensions. The grid should be large enough to encompass the entire PTV. You also need to decide on the grid resolution, which is how finely the space is divided. A common choice might be a 1mm resolution, but this depends on the level of detail required for your analysis.
2. **Calculate Grid Boundaries:** Based on the PTV's center and radius, calculate the boundaries of the grid in each dimension (x, y, z). For example, if the PTV is a sphere with a center at (x_c, y_c, z_c) and a radius r , your grid boundaries in each dimension would be from $x_c - r$ to $x_c + r$, $y_c - r$ to $y_c + r$, and $z_c - r$ to $z_c + r$.
3. **Create Grid Points:** Use MATLAB's `meshgrid` function to create a 3D grid of points. `meshgrid` will give you matrices for X, Y, and Z coordinates of each grid point.
4. **Filter Out Points Outside the PTV:** If the PTV is not a perfect cube but a sphere or ellipsoid, you'll need to remove points outside the PTV. For a spherical PTV, you can do this by keeping only those points that satisfy the equation $(x - x_c)^2 + (y - y_c)^2 + (z - z_c)^2 \leq r^2$.

15. Compute Volume Dose in OAR