

Assignment 2 Part I - Alisa Zhang (worked with Keegan Blain and Laila Alamri)

1. Part I:

Assignment - Part I

① $P_1(5,0,0)$ $\vec{12} = P_2 - P_1 = \langle -5, 0, 5 \rangle$

$P_2(0,0,5)$ $\vec{23} = P_3 - P_2 = \langle -10, 0, 0 \rangle$

$P_3(10,0,5)$

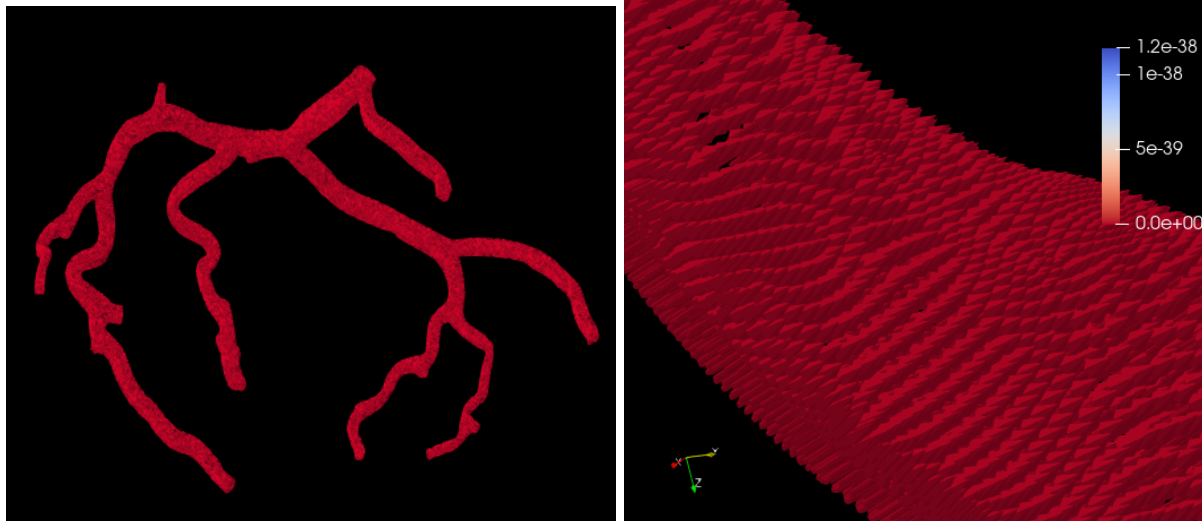
$$\vec{12} \times \vec{23} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -5 & 0 & 5 \\ -10 & 0 & 0 \end{vmatrix}$$

$$= \langle (0)(0) - (0)(5), -((-5)(0) - (-10)(5)), (-5)(0) - (-10)(0) \rangle$$

$$= \langle 0, -50, 0 \rangle$$

See MATLAB file for function.

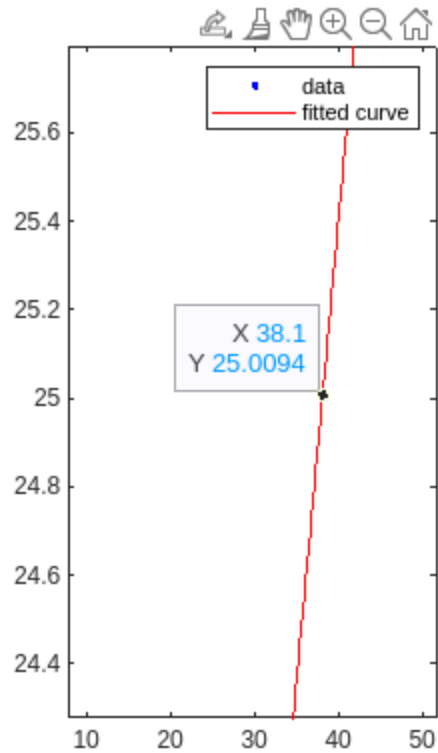
Part II: See MATLAB file for work, paraview is below (zoomed in to show glyphs).



2. **Part I:** Using the graph below on MATLAB, in order to obtain 25keV energy absorption, you need a temperature of $T=38.1C$.

`fitresult =`

```
Linear model Poly3:
fitresult(x) = p1*x^3 + p2*x^2 + p3*x + p4
Coefficients (with 95% confidence bounds):
p1 = -6.194e-06 (-6.453e-05, 5.214e-05)
p2 = 0.001369 (-0.001104, 0.003842)
p3 = 0.1325 (0.02353, 0.2415)
p4 = 18.32 (15.68, 20.96)
```



Part II:

②

$$\begin{matrix}
 & A & \vec{x} & b \\
 \begin{bmatrix} T_1^3 & T_1^2 & T_1 & 1 \\ T_2^3 & T_2^2 & T_2 & 1 \\ T_3^3 & T_3^2 & T_3 & 1 \\ T_4^3 & T_4^2 & T_4 & 1 \end{bmatrix} & \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ a_3 \end{bmatrix} & = & \begin{bmatrix} E_1 \\ E_2 \\ E_3 \\ E_4 \end{bmatrix}
 \end{matrix}$$

$E(t) = a + b^*t$
 $A\vec{x} = b$
 $x = (A^T A)^{-1} A^T b$

$$\begin{matrix}
 A & \vec{x} & b \\
 \begin{bmatrix} 1 & -40 \\ 1 & -20 \\ 1 & 0 \\ 1 & 20 \\ 1 & 25 \\ 1 & 40 \\ 1 & 60 \end{bmatrix} & \begin{bmatrix} a \\ b \end{bmatrix} & = \begin{bmatrix} 15.4 \\ 16.7 \\ 18.6 \\ 19.8 \\ 22.7 \\ 26.6 \\ 29.5 \end{bmatrix}
 \end{matrix}$$

$$A^T A = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ -40 & -20 & 0 & 20 & 25 & 40 & 60 \end{bmatrix}$$

$$A^T b = \begin{bmatrix} 149.3 \\ 2847.5 \end{bmatrix}$$

$$\begin{bmatrix} 1 & -40 \\ 1 & -20 \\ 1 & 0 \\ 1 & 20 \\ 1 & 25 \\ 1 & 40 \\ 1 & 60 \end{bmatrix} = \begin{bmatrix} 7 & 85 \\ 85 & 8225 \end{bmatrix}$$

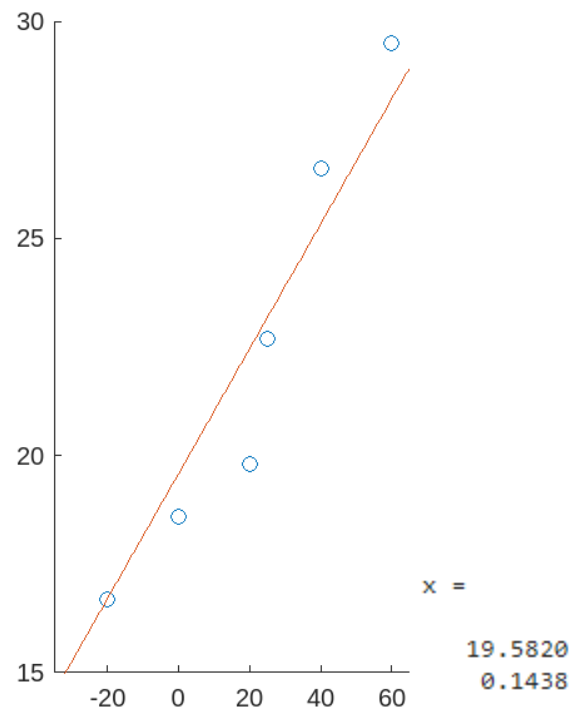
$$x = (A^T A)^{-1} A^T b$$

$$= \left(\frac{1}{(-7)(8225) - (85)(85)} \right) \begin{bmatrix} 8225 & -85 \\ -85 & 7 \end{bmatrix} \begin{bmatrix} 149.3 \\ 2847.5 \end{bmatrix} = \begin{bmatrix} 0.163 & -0.0169 \\ -0.00619 & 1.39e-4 \end{bmatrix} \begin{bmatrix} 149.3 \\ 2847.5 \end{bmatrix} = \begin{bmatrix} 19.58 \\ .144 \end{bmatrix}$$

$E(t) = 19.58 + .144t$

Using the above function, in order to obtain 25keV energy absorption, you need a temperature of $T=37.64^\circ\text{C}$.

Part III:



Using the backslash operator in MATLAB results in almost the same answer, with some discrepancies probably due to rounding between steps in my work on paper, so the interpolated $T=37.68^{\circ}\text{C}$.