Question 1-1.10-4

EE24BTECH11015 - Dhawal

1) Find the unit vector in the direction of sum of vectors $\mathbf{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\mathbf{b} = 2\hat{j} + \hat{k}$.

Variable	Description	Values
a	Vector given	$\left(2, -1, 1\right)$
b	Vector given	$\left(0, 2, 1\right)$
P	Unit vector in $\mathbf{a} + \mathbf{b}$	To Find

TABLE 1: Variables Used

Solution:

As **P** is a unit vector:

$$\mathbf{P} = \frac{\mathbf{a} + \mathbf{b}}{\left\|\mathbf{a} + \mathbf{b}\right\|} \tag{1.1}$$

Finding $\mathbf{a} + \mathbf{b}$:

$$\mathbf{a} + \mathbf{b} = \begin{pmatrix} 2 \\ -1 \\ 1 \end{pmatrix} + \begin{pmatrix} 0 \\ 2 \\ 1 \end{pmatrix} = \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix} \tag{1.2}$$

Finding $\left\|\mathbf{a} + \mathbf{b}\right\|$:

$$\left\|\mathbf{a} + \mathbf{b}\right\| = \sqrt{\begin{pmatrix} 2 & 1 & 2 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix}} = \sqrt{9} = 3 \tag{1.3}$$

Putting the values in the equation:

$$\mathbf{P} = \frac{1}{3} \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix} = \begin{pmatrix} \frac{2}{3} \\ \frac{1}{3} \\ \frac{2}{3} \end{pmatrix} \tag{1.4}$$

Hence unit vector in direction of $\mathbf{a} + \mathbf{b}$ is $\frac{2}{3}\hat{i} + \frac{1}{3}\hat{j} + \frac{2}{3}\hat{k}$
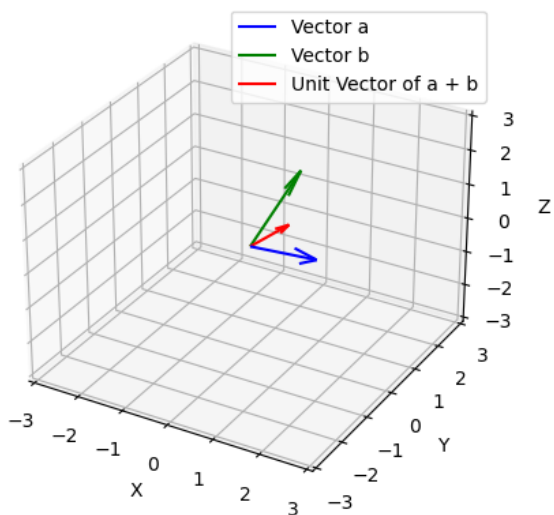
Fig. 1.1: Locus of **P**