1.9.15

EE25BTECH11026-Harsha

Question:
If a, b, c are position vectors of the points A(2, 3, −4), B(3, −4, −5), and C(3, 2, −3) respectively, then $\|a + b + c\|$ is equal to
Solution:
Let us solve the given equation theoretically and then verify the solution computationally
According to the question,
Given the position vectors,

$$\mathbf{a} = \begin{pmatrix} 2 \\ 3 \\ 4 \end{pmatrix} \mathbf{b} = \begin{pmatrix} 3 \\ -4 \\ -5 \end{pmatrix} \mathbf{c} = \begin{pmatrix} 3 \\ 2 \\ -3 \end{pmatrix} \tag{0.1}$$

To find the magnitude of $\|a + b + c\|$,we can add these three vectors to find their sum, say S, and find their magnitude.

$$\mathbf{S} = \mathbf{a} + \mathbf{b} + \mathbf{c} \tag{0.2}$$

$$\mathbf{S} = \begin{pmatrix} 2 \\ 3 \\ -4 \end{pmatrix} + \begin{pmatrix} 3 \\ -4 \\ -5 \end{pmatrix} + \begin{pmatrix} 3 \\ 2 \\ -3 \end{pmatrix} \tag{0.3}$$

$$\therefore \mathbf{S} = \begin{pmatrix} 8 \\ 1 \\ -12 \end{pmatrix} \tag{0.4}$$

The magnitude of S is given by

$$\|S\|^2 = \mathbf{S}^T\mathbf{S} \tag{0.5}$$

$$\therefore \|S\|^2 = \begin{pmatrix} 8 & 1 & -12 \end{pmatrix} \begin{pmatrix} 8 \\ 1 \\ -12 \end{pmatrix} \tag{0.6}$$

$$\|S\|^2 = \begin{pmatrix} 209 \end{pmatrix} \tag{0.7}$$

$$\therefore \|S\| = \begin{pmatrix} 14.457 \end{pmatrix} \ units \tag{0.8}$$

From the figure it is clearly verified that the theoretical solution matches with the computational solution.