EE3900 : Assignment-1

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1 QUESTION: VECTORS Q2.27

Find the area of a parallelogram whose adjacent sides are determined by the vectors:

$$\mathbf{a} = \begin{pmatrix} 1 \\ -1 \\ 3 \end{pmatrix} \text{ and } \mathbf{b} = \begin{pmatrix} 2 \\ -7 \\ 1 \end{pmatrix}.$$

2 SOLUTION

The area of the required parallelogram is defined as:

$$\|\mathbf{a} \times \mathbf{b}\| \tag{2.0.1}$$

where

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} 0 & -a_3 & a_2 \\ a_3 & 0 & -a_1 \\ -a_2 & a_1 & 0 \end{pmatrix} \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix} \tag{2.0.2}$$

since cross product of two vectors is determined by spanning a vector into skew symmetric matrix. Therefore,

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} 0 & -3 & -1 \\ 3 & 0 & -1 \\ 1 & 1 & 0 \end{pmatrix} \begin{pmatrix} 2 \\ -7 \\ 1 \end{pmatrix} = \begin{pmatrix} 20 \\ 5 \\ -5 \end{pmatrix} \tag{2.0.3}$$

Thus, the desired area is

$$\|\mathbf{a} \times \mathbf{b}\| = \sqrt{(20)^2 + (5)^2 + (-5)^2} \tag{2.0.4}$$

$$= 15\sqrt{2} \tag{2.0.5}$$