Cross Product

$$\begin{bmatrix} a_{21} \\ a_{22} \\ a_{23} \end{bmatrix} \times \begin{bmatrix} a_{31} \\ a_{32} \\ a_{33} \end{bmatrix} = \begin{bmatrix} i & j & k \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} = (-1)^{1+1} i \det m_i + (-1)^{1+2} j \times \det m_j + (-1)^{1+3} k \times \det m_k$$

$$= i \det m_i - j \det m_j + k \det m_k$$

$$= a_{22} a_{33} i - a_{23} a_{32} j + k a_{21} a_{33}$$

where

$$m_i = \begin{bmatrix} a_{22} & a_{23} \\ a_{32} & a_{33} \end{bmatrix}$$

$$m_j = \begin{bmatrix} a_{21} & a_{23} \\ a_{31} & a_{33} \end{bmatrix}$$

$$m_k = \begin{bmatrix} a_{21} & a_{22} \\ a_{31} & a_{32} \end{bmatrix}$$