Example Vector Calculations

Scalars:

$a := 1$ $b := 2$

2D Vector Magnitudes and Angles:

$A := 3$ $\theta_A := 45 \cdot deg$ $B := 4$ $\theta_B := 60 \cdot deg$

Vectors in rectangular form:

$A_x := A \cdot \cos(\theta_A)$ $A_x = 2.121$ $B_x := B \cdot \cos(\theta_B)$ $B_x = 2$

$A_y := A \cdot \sin(\theta_A)$ $A_y = 2.121$ $B_y := B \cdot \sin(\theta_B)$ $B_y = 3.464$

To calculate weighted vector sum: **S** = a**A** + b**B**

$S_x := a \cdot A_x + b \cdot B_x$ $S_x = 6.121$

$S_y := a \cdot A_y + b \cdot B_y$ $S_y = 9.05$

$S := \sqrt{S_x^2 + S_y^2}$ $S = 10.925$

$\theta_S := \text{angle}(S_x, S_y)$ $\theta_S = 55.925\ deg$

To calculate phasor product: P = **AB**

$P := A \cdot B$ $P = 12$

$\theta_P := \theta_A + \theta_B$ $\theta_P = 105\ deg$

$P_x := P \cdot \cos(\theta_P)$ $P_x = -3.106$

$P_y := P \cdot \sin(\theta_P)$ $P_y = 11.591$

To calculate dot product: D = **A** dot **B**:

$D := A_x \cdot B_x + A_y \cdot B_y$ $D = 11.591$

To calculate cross product: **C** = **A** x **B**:

$C_x := 0$ $C_y := 0$

$C_z := A_x \cdot B_y - A_y \cdot B_x$ $C_z = 3.106$

Vectors as Complex Numbers (2D vectors only):

$\mathbf{A} := A_x + i \cdot A_y$

$|\mathbf{A}| = 3$

$\arg(\mathbf{A}) = 45\,deg$

$\mathbf{B} := B_x + i \cdot B_y$

$|\mathbf{B}| = 4$

$\arg(\mathbf{B}) = 60\,deg$

or

$\mathbf{A} := A \cdot e^{i \cdot \theta_A}$ $\quad \mathbf{A} = 2.121 + 2.121i$

$\mathbf{B} := B \cdot e^{i \cdot \theta_B}$ $\quad \mathbf{B} = 2 + 3.464i$

$\mathbf{S} := a \cdot \mathbf{A} + b \cdot \mathbf{B}$

$|\mathbf{S}| = 10.925$

$\arg(\mathbf{S}) = 55.925\,deg$

$\mathbf{P} := \mathbf{A} \cdot \mathbf{B}$

$|\mathbf{P}| = 12$

$\arg(\mathbf{P}) = 105\,deg$

For other vector calculations (e.g., dot and cross products), you must convert the complex numbers back to rectangular form:

$A_x := \mathrm{Re}(\mathbf{A})$ $\quad A_x = 2.121$ $\qquad B_x := \mathrm{Re}(\mathbf{B})$ $\quad B_x = 2$

$A_y := \mathrm{Im}(\mathbf{A})$ $\quad A_y = 2.121$ $\qquad B_y := \mathrm{Im}(\mathbf{B})$ $\quad B_y = 3.464$

$S_x := \mathrm{Re}(\mathbf{S})$ $\quad S_x = 6.121$ $\qquad P_x := \mathrm{Re}(\mathbf{P})$ $\quad P_x = -3.106$

$S_y := \mathrm{Im}(\mathbf{S})$ $\quad S_y = 9.05$ $\qquad P_y := \mathrm{Im}(\mathbf{P})$ $\quad P_y = 11.591$

Vectors as Single Column (or single row) Matrices (for vectors of any dimension):

$\mathbf{A} := \begin{pmatrix} A_x \\ A_y \end{pmatrix}$ $\quad |\mathbf{A}| = 3$ $\qquad \mathbf{B} := \begin{pmatrix} B_x \\ B_y \end{pmatrix}$ $\quad |\mathbf{B}| = 4$

$\mathbf{S} := a \cdot \mathbf{A} + b \cdot \mathbf{B}$ $\quad |\mathbf{S}| = 10.925$ $\qquad \mathbf{S} = \begin{pmatrix} 6.121 \\ 9.05 \end{pmatrix}$

$D := \mathbf{A} \cdot \mathbf{B}$ $\quad D = 11.591$

$\mathbf{A} := \begin{pmatrix} A_x \\ A_y \\ 0 \end{pmatrix}$ $\qquad \mathbf{B} := \begin{pmatrix} B_x \\ B_y \\ 0 \end{pmatrix}$

$\mathbf{C} := \mathbf{A} \times \mathbf{B}$ $\qquad \mathbf{C} = \begin{pmatrix} 0 \\ 0 \\ 3.106 \end{pmatrix}$

To extract rectangular components:

$C_x := \mathbf{C}_0$ $\quad C_x = 0$ $\qquad C_y := \mathbf{C}_1$ $\quad C_y = 0$ $\qquad C_z := \mathbf{C}_2$ $\quad C_z = 3.106$