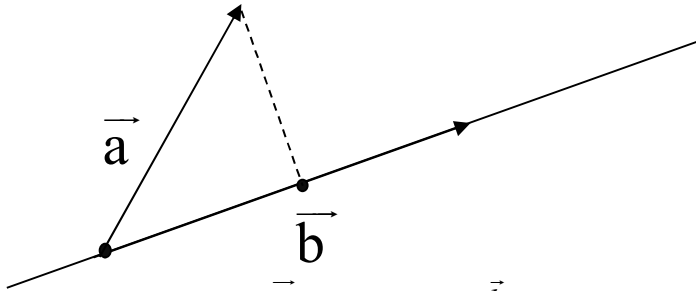


## Projection of a vector $\vec{a}$ ( $a_1, a_2, a_3$ ) onto vector $\vec{b}$ ( $b_1, b_2, b_3$ )

Given: Vectors  $\vec{a}$  ( $a_1, a_2, a_3$ ) and  $\vec{b}$  ( $b_1, b_2, b_3$ )

Find the Projection of a vector  $\vec{a}$  ( $a_1, a_2, a_3$ ) onto vector  $\vec{b}$  ( $b_1, b_2, b_3$ )



VPR is the vector projection of a vector  $\vec{a}$  onto vector  $\vec{b}$

SPR is the scalar projection of a vector  $\vec{a}$  onto vector  $\vec{b}$

$$1) \vec{a} \cdot \vec{b} = |\vec{a}| \cdot |\vec{b}| \cdot \cos(\vec{a} \wedge \vec{b})$$

$$2) \vec{e}_{\vec{b}} = \frac{\vec{b}}{|\vec{b}|} \text{ (unit vector in the direction } \vec{b} \text{)}$$

$$3) \text{VPR} = \vec{P}roj_{\vec{b}} \vec{a} = |\vec{a}| \cdot \cos(\vec{a} \wedge \vec{b}) \cdot \frac{\vec{b}}{|\vec{b}|}$$

$$4) \text{SPR} = \text{Proj}_{\vec{b}} \vec{a} = |\vec{a}| \cdot \cos(\vec{a} \wedge \vec{b}) = \frac{\vec{a} \cdot \vec{b}}{|\vec{b}|}$$

$$5) \text{VPR} = \vec{P}roj_{\vec{b}} \vec{a} = |\vec{a}| \cdot \cos(\vec{a} \wedge \vec{b}) \cdot \frac{\vec{b}}{|\vec{b}|} = \frac{\vec{a} \cdot \vec{b}}{|\vec{b}|} \cdot \frac{\vec{b}}{|\vec{b}|} = \frac{\vec{a} \cdot \vec{b}}{|\vec{b}|^2} \cdot \vec{b}$$

$$6) |\text{SPR}| = \left| \vec{P}roj_{\vec{b}} \vec{a} \right| = \left| \frac{\vec{a} \cdot \vec{b}}{|\vec{b}|^2} \cdot \vec{b} \right| = \frac{|\vec{a} \cdot \vec{b}|}{|\vec{b}|^2} \cdot |\vec{b}| = \frac{|\vec{a} \cdot \vec{b}|}{|\vec{b}|}$$

$$7) \text{SPR} = \text{Proj}_{\vec{b}} \vec{a} = \frac{a_1 \cdot b_1 + a_2 \cdot b_2 + a_3 \cdot b_3}{\sqrt{b_1^2 + b_2^2 + b_3^2}}$$

$$8) \text{VPR} = \vec{P}roj_{\vec{b}} \vec{a} = \frac{a_1 \cdot b_1 + a_2 \cdot b_2 + a_3 \cdot b_3}{b_1^2 + b_2^2 + b_3^2} \cdot (b_1, b_2, b_3) =$$

Final formula:

$$9) \text{VPR} = \left( \frac{a_1 \cdot b_1 + a_2 \cdot b_2 + a_3 \cdot b_3}{b_1^2 + b_2^2 + b_3^2} \cdot b_1, \frac{a_1 \cdot b_1 + a_2 \cdot b_2 + a_3 \cdot b_3}{b_1^2 + b_2^2 + b_3^2} \cdot b_2, \frac{a_1 \cdot b_1 + a_2 \cdot b_2 + a_3 \cdot b_3}{b_1^2 + b_2^2 + b_3^2} \cdot b_3 \right)$$

