

Topic

Relative Motion Analysis: Acceleration

Governing Equations and Assumptions

$$\left. \begin{aligned} \vec{a}_B &= \vec{a}_A + (\vec{\omega}_{AB} \times \vec{r}_{B/A}) - \omega_{AB}^2 \vec{r}_{B/A} \\ \vec{v}_B &= \vec{v}_A + \vec{\omega}_{AB} \times \vec{r}_{B/A} \end{aligned} \right\} \text{General Plane Motion}$$

$$\left. \begin{aligned} \vec{v} &= \vec{\omega} \times \vec{r} \\ \vec{a} &= (\vec{\alpha} \times \vec{r}) - \omega^2 \vec{r} \end{aligned} \right\} \text{Rotation about a Fixed Axis}$$

Process

- ① Velocity Analysis
  - (a) Find the velocity at one point (Rotation about a Fixed Axis)
  - (b) Relative Motion Analysis
 
$$\vec{v}_B = \vec{v}_A + \vec{\omega}_{AB} \times \vec{r}_{B/A} \Rightarrow 2 \text{ Equations } \begin{pmatrix} \hat{i} \text{-comp} \\ \hat{j} \text{-comp} \end{pmatrix}$$

$$\Rightarrow \text{Solve for } \vec{v}_B \text{ and } \omega_{AB}$$
- ② Acceleration Analysis
  - (a) Find the acceleration at one point (Rotation about a Fixed Axis)
  - (b) Relative Motion Analysis
 
$$\vec{a}_B = \vec{a}_A + (\vec{\alpha}_{AB} \times \vec{r}_{B/A}) - \omega_{AB}^2 \vec{r}_{B/A} \Rightarrow 2 \text{ Equation } \begin{pmatrix} \hat{i} + \hat{j} \end{pmatrix}$$

$$\Rightarrow \text{Solve for } \vec{a}_B \text{ and } \alpha_{AB}$$