Lecture Module - Dynamics Review

ME3050 - Dynamic Modeling and Controls

Mechanical Engineering

Tennessee Technological University

Topic 1 - Describing Motion

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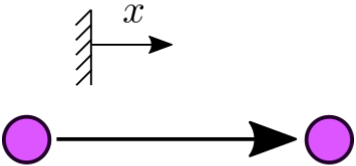
- Translation
- Rotation
- Equations of Rotations
- Degrees of Freedom

Translation

Translational motion is:

- motion along a straight line.
- rotation about a point far away?

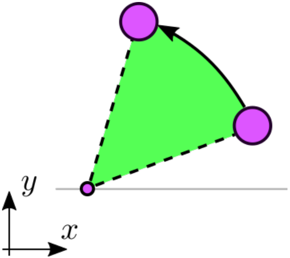


Position	$x(t)$
Velocity	$v_x(t) = \frac{dx(t)}{dt} = \dot{x}$
Acceleration	$a_x(t) = \frac{dv(t)}{dt} = \frac{d^2x(t)}{dt^2} = \ddot{x}$

Rotation

Rotational motion is:

- motion along a circular path about a fixed point or axis
- acceleration towards the center of rotation



Angular Position	$\theta_z(t)$
Angular Velocity	$\omega_z(t) = \frac{d\theta(t)}{dt} = \dot{\theta}$
Angular Acceleration	$\alpha_z(t) = \frac{d\omega(t)}{dt} = \frac{d^2\theta(t)}{dt^2} = \ddot{\theta}$

Equations of Rotation

You used these important relationships in your dynamics course.

$\vec{v} = \vec{r} \times \vec{\omega}$

With the planar motion assumption this vector equation can be reduced to scalar equation.

$v = r\omega$

Degrees of Freedom

The Degrees of Freedom is the number of independent motions that exist in a system.

OR

The Degrees of Freedom is the minimum number of coordinates required to completely describe motion or state of the system.

DOF Examples

Find the degrees of freedom for each of the following systems.

Wittener Metronome

Image: Wikipedia

Passenger Aircraft

Image: Wikipedia

Ackermann Steeting Mechanism

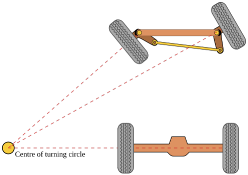


Image: Wikipedia