

## Module 2 - Dynamics Review

ME3050 - Dynamics Modeling and Controls

May 29, 2020

### Topic 4 - Rotation and Translation

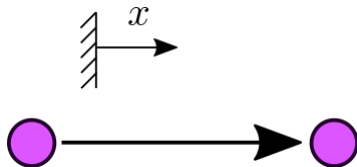
## Topic 4 - Rotation and Translation

- Translation
- Rotation
- Degrees of Freedom
- DOF Examples

# Translation

Translational motion is:

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

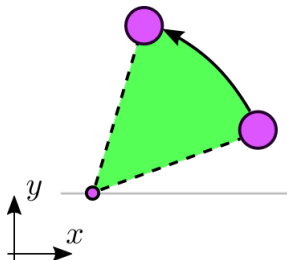


Position	$x(t)$
Velocity	$v_x(t) = \frac{dx(t)}{dt} = \dot{x}$
Acceleration	$a_x(t) = \frac{dv(t)}{dt} = \frac{d^2x(t)}{dt^2} = \ddot{x}$

# 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 Steering Mechanism

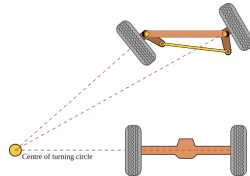


Image: Wikipedia