

Dynamics Review - Topic 4

ME3050 - Dynamics Modeling and Controls

May 29, 2020

Topic 4 - Describing Motion

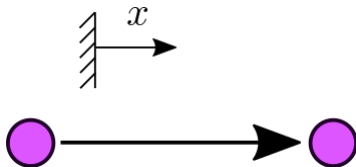
Topic 4 - Describing Motion

- Translation
- Rotation
- Degrees of Freedom
- DOF Examples

Translation

Translational motion is:

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

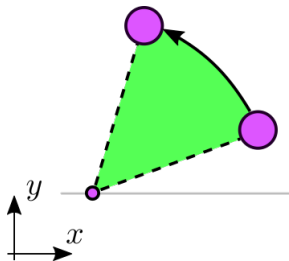


| | |
|--------------|---|
| Position | $x(t)$ |
| Velocity | $v_x(t) = \frac{dx(t)}{dt} = \dot{x}$ |
| Acceleration | $a_x(t) = \frac{dv(t)}{dt} = \frac{d^2x(t)}{dt^2} = \ddot{x}$ |

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

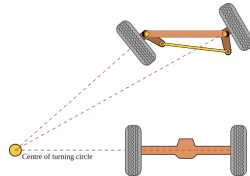


Image: Wikipedia