Module 2 - Dynamics Review

ME3050 - Dynamic Modeling and Controls

Mechanical Engineering

Tennessee Technological University

Topic 3 - Particles and Bodies

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- Using Different Coordinate Systems
- Particle Motion
- Rigid Body Motion
- Is rigid body motion realistic?

Particle Motion

In your dynamics course you derived and used these equations.

$$\vec{v}(t) = \frac{d\vec{r}}{dt} = v\hat{e}_t$$

$$\vec{a}(t) = \frac{d\vec{v}}{dt} = \dot{v}\hat{e}_t + \vec{v}\frac{ds}{dt}\frac{d\hat{e}_t}{ds} = \dot{v}\hat{e}_t + \frac{\nu^2}{\rho}\hat{e}_n$$

$$\frac{d\hat{e}_t}{ds} = \kappa\hat{e}_n$$

Do you remember these? Do they make sense to you?

Rigid Body Motion

$$\frac{d}{dt}|r_{pq}|^2 = \frac{d}{dt}(\vec{r}_{pq} \cdot \vec{r}_{pq}) = 2\vec{r}_{pq} \cdot \frac{d\vec{r}_{pq}}{dt} = 0$$

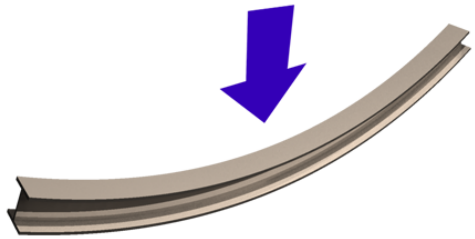
In a rigid body motion, the body remains rigid and does not deform. This is intuitive but In mechanics a different definition is used.

In a rigid body motion all points on a single body rotate about a common point in space at the same anguar velocity. This point is known as the instantaneous center of rotation (ICR).

Is rigid body motion realistic?

Consider a typical hobbyist quadcopter. Is the frame rigid?

Is flight a rigid body motion?



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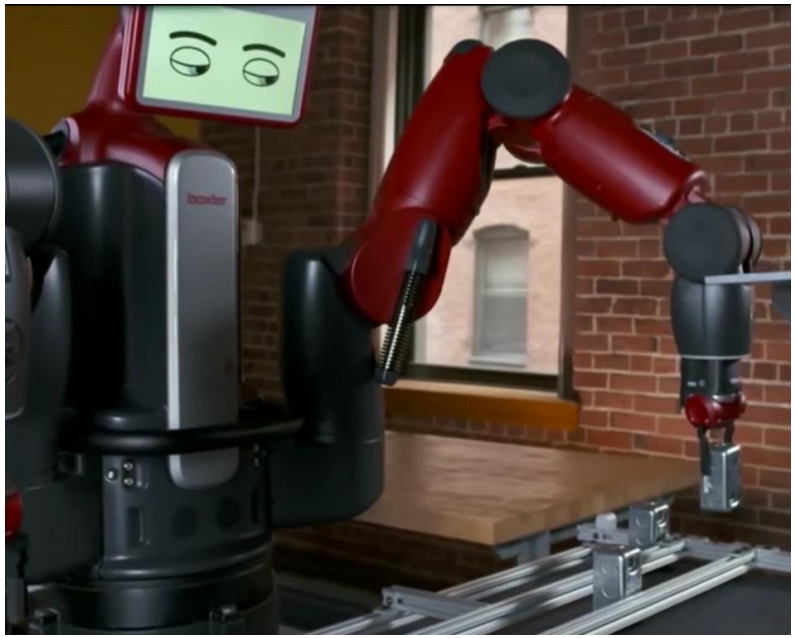
Example of Non-Rigid Body Motion or System

Traditionally engineers build machines that are strong and stiff. Name one machine that must be as strong and stiff as possible.

Can you think of a machine or system that relies on a non-rigid body motion or system?



Motion in ME3050

In DMC we will study systems that undergo simple motions.

Therefore, we will focus on the system dynamics of translational and rotational engineering problems in which the motion is contrained to straightline or circlar paths.