Newton's Second in Rotation Fixed Axis Rotation Instantaneous Center of Rotation Engineering Applications

## Module 5 - Rotation Systems

ME3050 - Dynamics Modeling and Controls

Mechanical Engineering
Tennessee Technological University

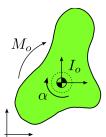
**Topic 1 - The Dynamics of Rotation** 

### **Topic 1 - The Dynamics of Rotation**

- Newton's Second in Rotation
- Fixed Axis Rotation
- Instantaneous Center of Rotation
- Engineering Applications

#### Newton's Second in Rotation

Newton's Second Law equates the mass moment of inertia to the angular acceleration of a rigid body.



$$\Sigma M_o = I_o \alpha = I_o \dot{\omega}$$

Images: T.Hill

## **Fixed Axis Rotation**

This expression is only valid for a system constrained to rotation about a fixed axis.

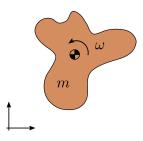


$$\Sigma M_o = I_o \alpha = I_o \dot{\omega}$$

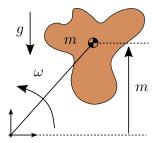
Images: T.Hill

#### Instantaneous Center of Rotation

As you know there is a kinetic energy associated with the rotating mass. If the rotation is in the vertical plane there is a gravitational potential.



$$KE = T = \frac{1}{2}I_o\omega^2$$



$$PE = V = mgy$$

# **Engineering Applications**

Rotating systems are used in machines and engineering systems of all types.

- IC engines
- Electric Motors
- Wheels, Gears, Transmissions
- ...