Module 3 - Newton's Approach

ME3050 - Dynamics Modeling and Controls

Mechanical Engineering

Tennessee Technological University

Topic 3 - The Velocity Model

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- Example Problem - Quadcoptor Model
- Mathematical Modeling
- Newton's Second Law Approach
- Derived Equations of Motion

Example Problem - Quadcoptor Model

Problem Statement - Derive the equations of motion using Newton's Second Law for the quadcopter velocity model.

Image: source needed

Mathematical Modeling

First, consider the physical problem and list all simplifying assumptions necessary or desired. In general, the designed should start simple and add complexity incrementally.

Quadcopter Model Assumptions:

1.
2.
3.

Newton's Second Law Approach

Newton's Second Law Approach

1. Draw a Free Body Diagram
2. Make an assumption of motion
3. Determine all forces acting on the system and their directions.
4. Write Newton's second law for the appropriate DOF.
5. Re-write the ODE in the standard form of a system equation.

Newton's Second Law Approach - Steps 1,2 and 3

Newton's Second Law Approach - Steps 4,5

Translation: $\Sigma \mathbf{F} = m\mathbf{a}$ $\quad \Sigma F_x = ma_x$, $\Sigma F_y = ma_y$, $\Sigma F_z = ma_z$

Rotation: $\Sigma \mathbf{M} = I_o \alpha$ $\quad \Sigma M_o = I_o \alpha_z$

Derived Equations of Motion