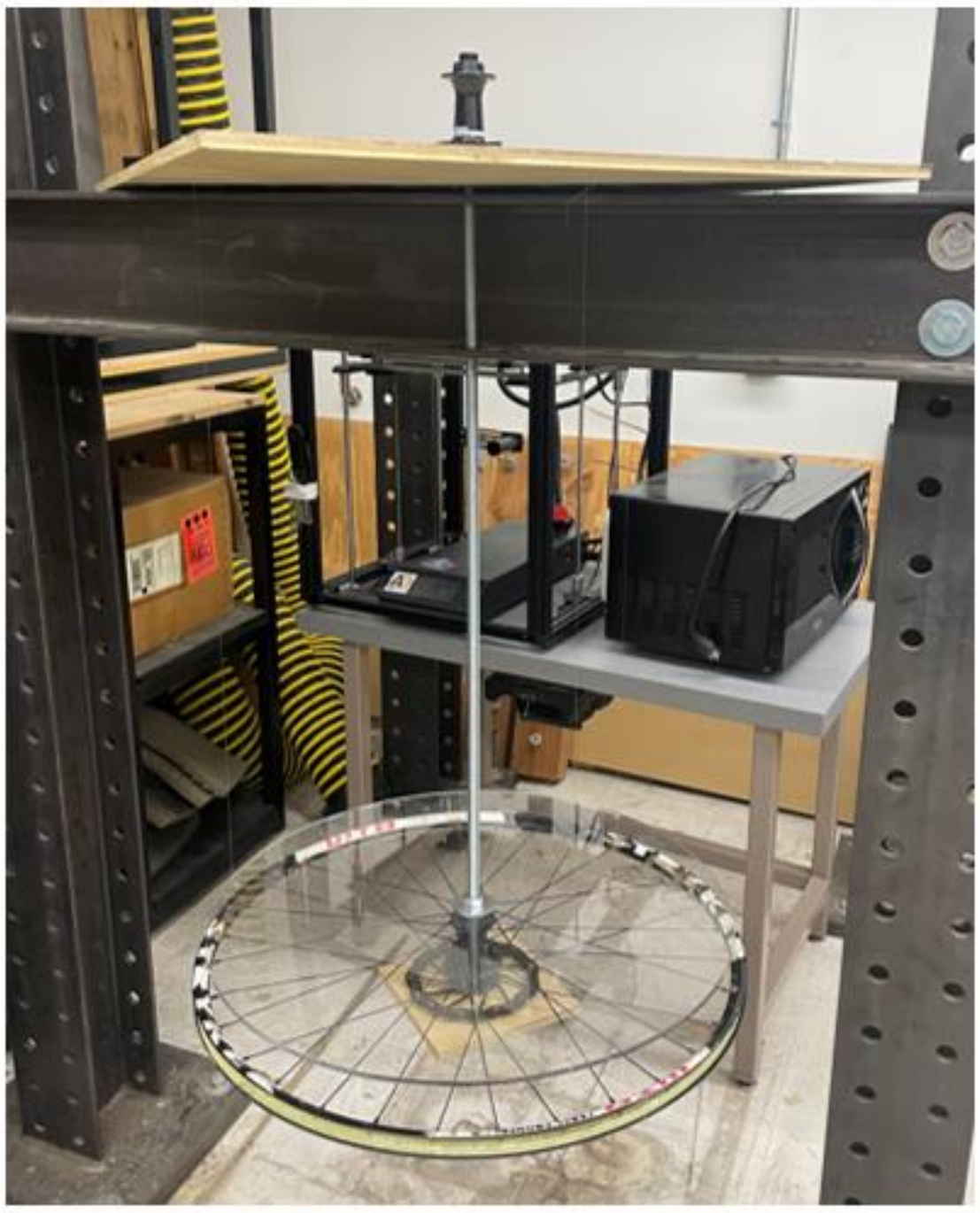
Extracting Mass Moments of Inertia from Irregular Objects

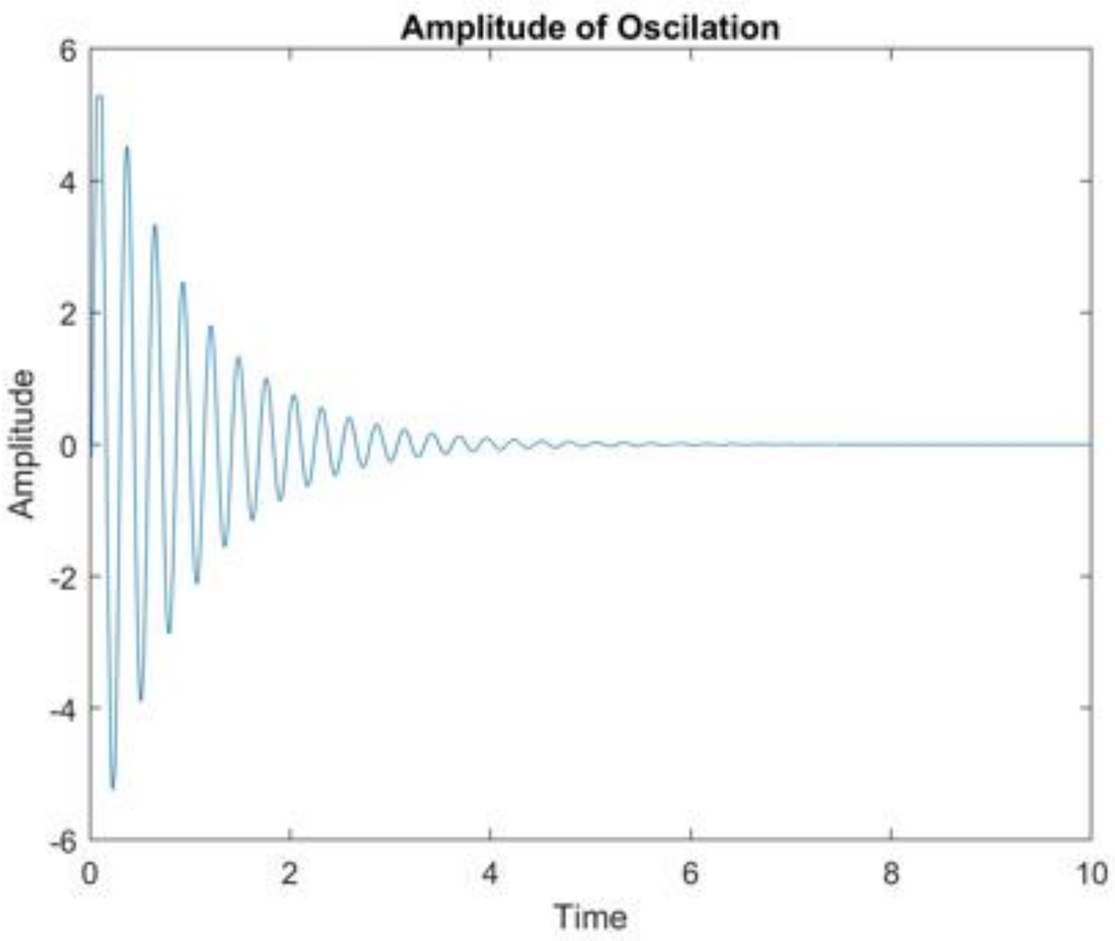
Will Helmen, Aerospace Engineering
Mentor: Marc Mignolet, SEMTE Graduate Department Chair
Ira A. Fulton School of Engineering

Research question: How can we demonstrate to students the mass moment of inertia for non-uniform objects?

Overview: Teaching students unique ways of measuring material properties using a modified pendulum that twists will encourage creative thinking.

Abstract: The moment of inertia of a body is the mass property that comes in when trying to accelerate/decelerate a body in rotation. It involves the total mass of the body but also how it is distributed around the point of rotation. Formulas to determine them are available for simple bodies, but for complex parts, e.g., a propeller blade or a gear, one must either use a CAD software or measure them. Such measurements can be done using a trifilar pendulum which is like a normal pendulum however instead of a mass swinging back and forth from a string, a trifilar utilizes three strings connected to a mass and twists side to side. The moment of inertia of the mass the strings are connected to determines how long each torsional oscillation takes. Thus, knowing the period of oscillation, the moment of inertia can be calculated. This project aims at creating an experimental setup that can be converted into a laboratory demonstration for students in the Vibration Analysis class. This experiment would give students practical insight into a unique problem-solving method and a deeper understanding of course material for Vibration Analysis.





$$\omega_0 = \sqrt{\frac{mgR^2}{I_G L}} = \sqrt{\frac{mg}{I_G}}\frac{R}{\sqrt{L}}$$

R = radius of supporting disc

L = length of string holding object

m = mass of system

g = gravitational acceleration

I_G = Moment of inertia about the center of gravity

ω_0 = Natural frequency of oscillation

FURI

Ira A. Fulton Schools of Engineering
Arizona State University