# Attitude Control Testbed In Vacuum

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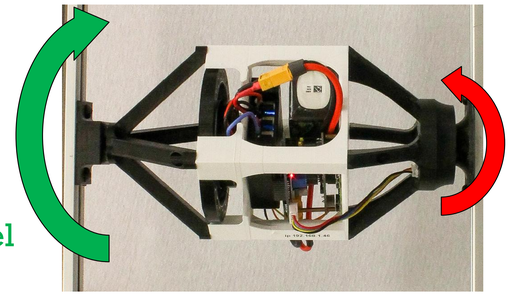
## ABSTRACT

Attitude Control Testbed in Vacuum (ACTIV) will be designed to simulate a microgravity environment with the use of 3 gimbal rings with embedded electric motors in each rotational axis to provide an opposing torque to those produced by gravity and friction.

This controlled gyroscope will be designed to test spacecraft ranging from 1U to 6U (as supplied by the CubeSat Control Platform project) in size so that varying spacecraft designs may be tested.

## CURRENT PROBLEM

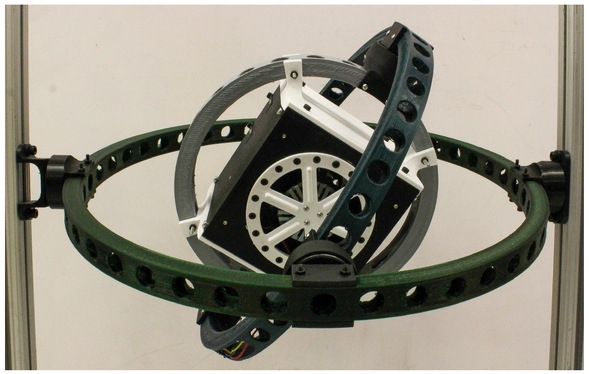
- Standard gimbal rings inherently **exert frictional forces** and **do not account for gravity**
- This system renders ground-based, realistic spacecraft attitude control **testing impossible**

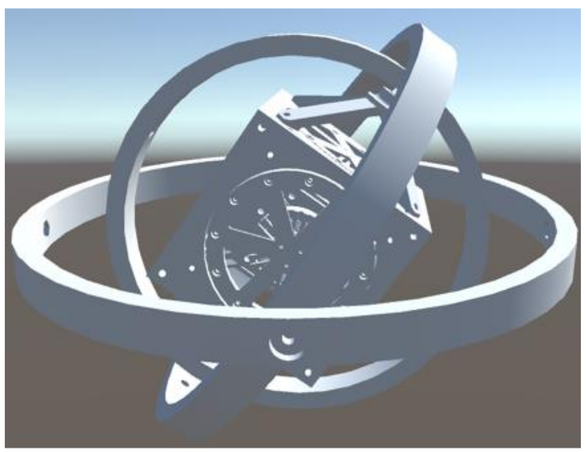



## ACTIV SOLUTION

- The 2nd Law of Thermodynamics demands that friction will always exist. So, we can instead **simulate** a **frictionless environment** by driving the gimbal rings with electric motors.
- Expanding on this, a **microgravity environment** can then be reproduced in the same manner by predicting and counteracting external torques with motors.
- This system will then be integrated into Easy Controls to enable **open-source spacecraft attitude control education/testing.**

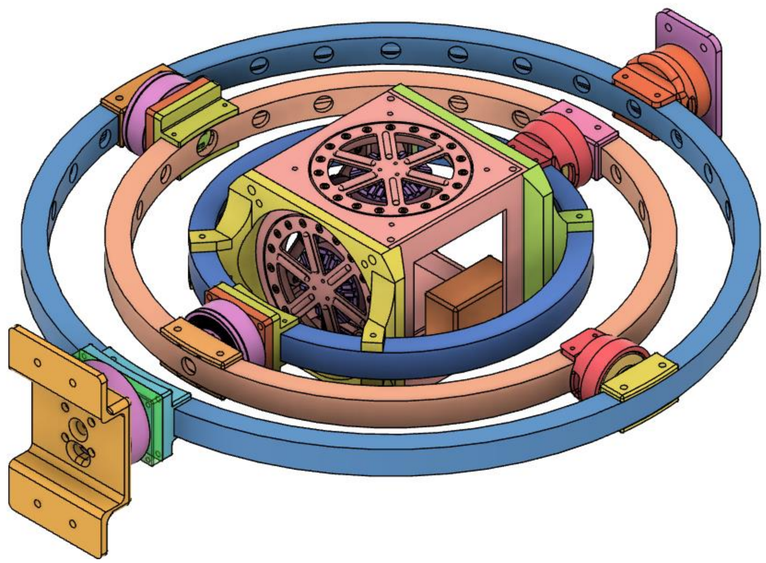
## CURRENT STATE





Unity Sim Generated by Encoder Data Where Φ=280°, θ=55°, ψ=10°.

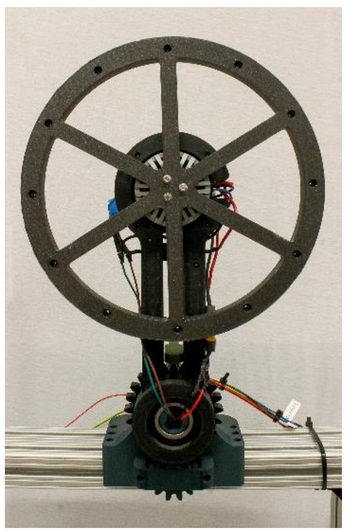
- 3DoF ACTIV assembled with manufacturing underway (2DoF previously assembled)
- Attitude determination leveraging embedded encoders successfully achieved using a 313 DCM



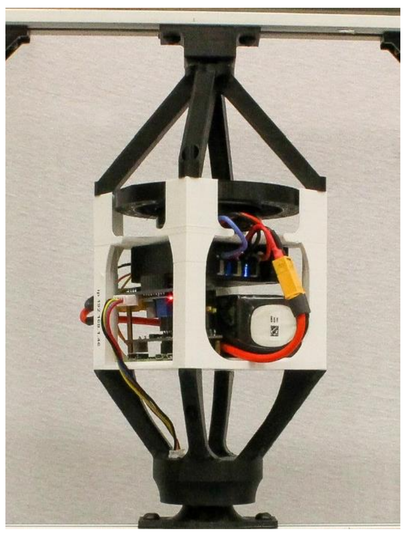
3DoF ACTIV with 3DoF CubeSat Integration

## EASY CONTROLS

Easy Controls allows for students and researchers to accelerate and expand their knowledge of control systems and algorithms by allowing hardware-in-the-loop testing in real-time on physical hardware through the internet. Platforms will include 1DoF and 3DoF CubeSat, inverted pendulum, and ISAAC (utilizes compressed air for propulsion).



Inverted Pendulum



1DoF CubeSat