Attitude Control Testbed In Vacuum

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ABSTRACT

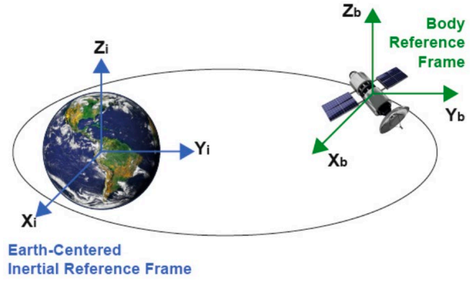
Attitude Control Testbed in Vacuum (ACTIV) will be designed to simulate a microgravity environment with the use of 3 gimbal rings with embedded electric motors in each rotational axis to provide an opposing torque to those produced by gravity and friction.

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.

PROJECT GOALS

Develop 3 degree of freedom, actively driven gimbal ring system to counteract gravitational and friction torques produced microgravity effect.

Develop an inverted pendulum, and 1, 3, and 6U CubeSat Control Platforms all of which utilize reaction wheels to change attitude.



EASY CONTROLS

EasyControls.org 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.

ACTIV, along with the inverted pendulum and CubeSat platforms, will be integrated into the website.

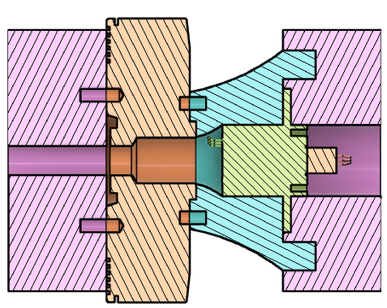
ACTIV

General System Architecture

Comprised of 3 gimbal rings, each ring will be mounted on a high-torque, hollow-shaft R80 motor. Shafts will be built into the rings to allow wires to pass. An external electronics bay will house the power source, the Raspberry Pi, ODrive controllers, and other electronics.

Rotary Union Point

Electrical continuity throughout rings will be accomplished using hollow-shaft motors in conjunction with slip rings.



ACTIV method to maintain continuity with R80 motor and slip ring

6U CubeSat 3DOF Stability in ACTIV

CURRENT STATE

General

Achieved multi-motor control using CAN; to be applied to both ACTIV and CubeSat platforms.

Reporting IMU data, sending motor commands, and storing data in SQ Lite database using threading.

Inverted Pendulum

Designed and assembled 1 degree of freedom inverted pendulum; currently tuning PID controller.

CubeSat

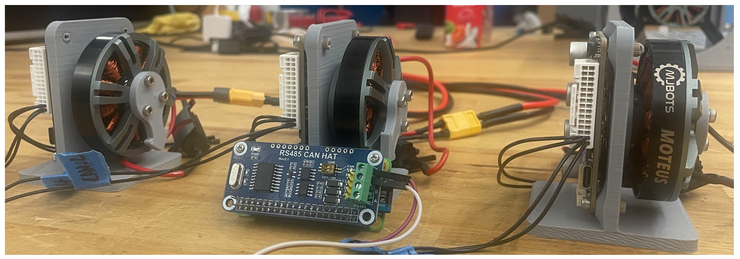
Assembled 1 degree of freedom CubeSat with ODrive controller, serving as testbed for IMU yaw drift mitigation.

Iterating upon 3 degree of freedom CubeSat design.

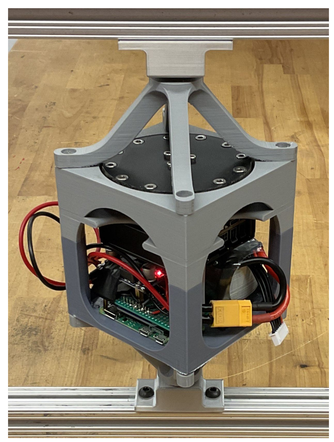
ACTIV

Torque estimations determined ideal motor which has been used to design rotary point.

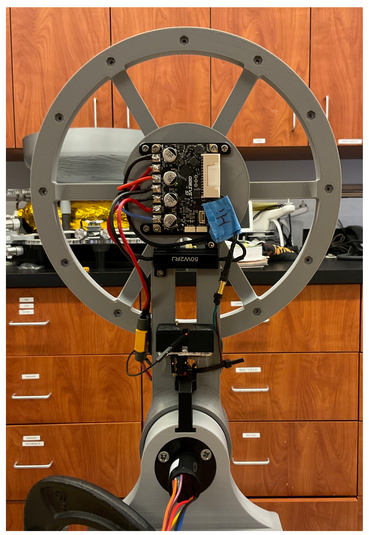
Manufacturing 1 degree of freedom configuration for initial testing prior to manufacturing full system.



Multi-motor control by utilizing CAN



1 DoF CubeSat with ODrive motor controller



Upright inverted pendulum