THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

8th Wernher von Braun Memorial Symposium
October 27 – 29, 2015

1954 2015 American Astronautical Society

Dynamic Modeling & Attitude Control of a High Altitude Balloon Payload

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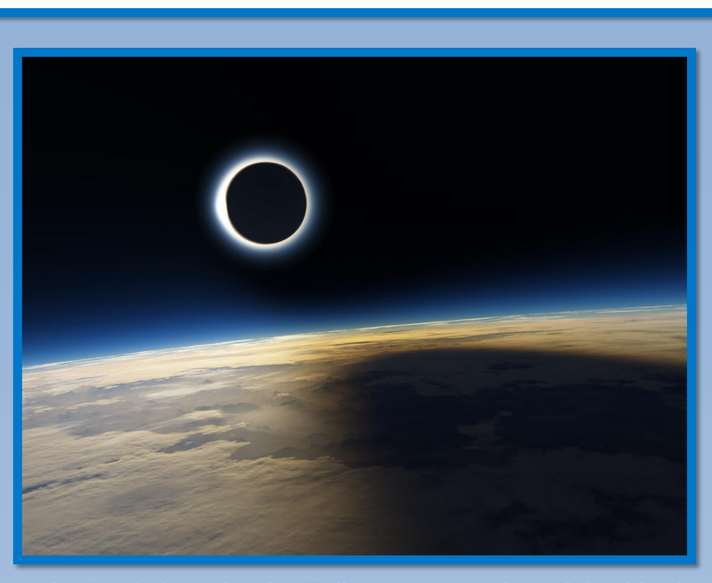
Mission & Motivation:

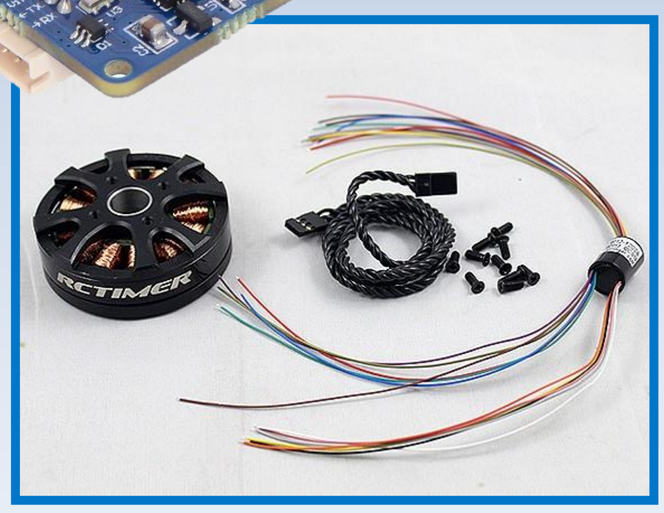
- Attitude stabilized and attitude controllable high-altitude/near space ballooning platform for UAH's Space Hardware Club
- Multiple applications for high altitude scientific experimentation & engineering applications
- *Central motivation:* Stabilized video of the 2017 Solar Eclipse from ~100,000 ft altitude
- Incremental development schedule
- First increment to achieve stabilization in yaw-axis (most unstable flight mode)



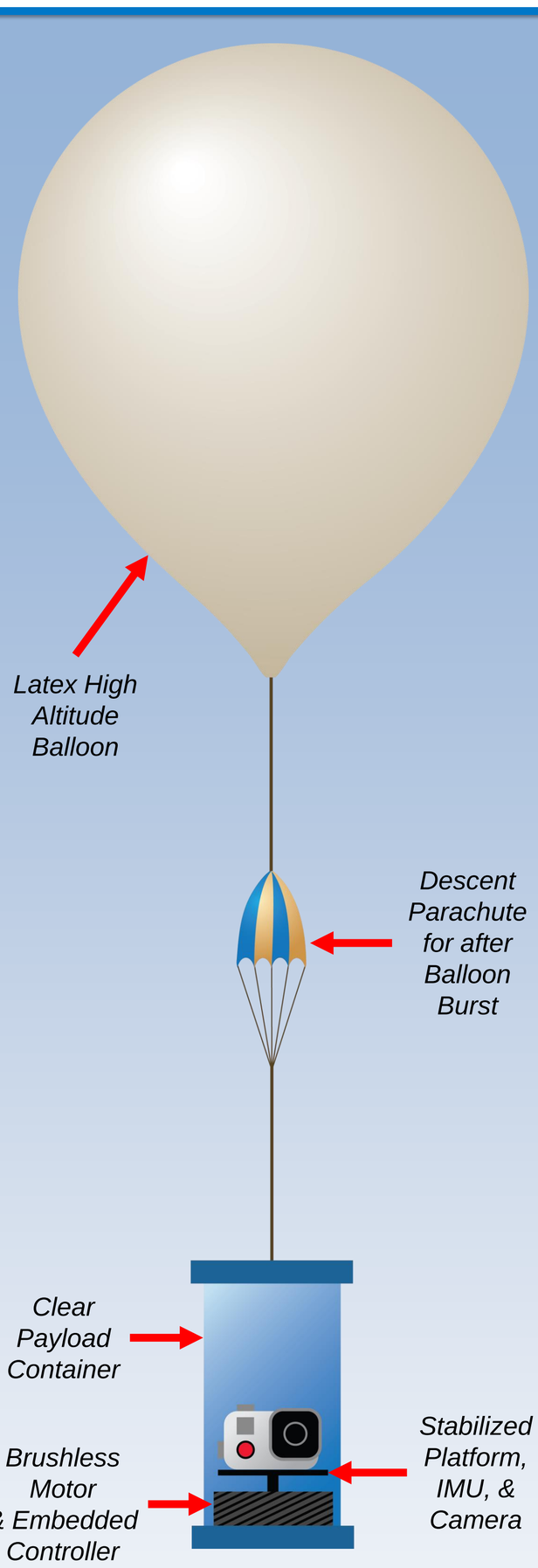
Artist Depiction of Solar Eclipse Captured at High Altitude

UAHuntsville's Space Hardware Club BalloonSat Launch

CMRobotics' UM7-LT DMP IMU+GPS Unit

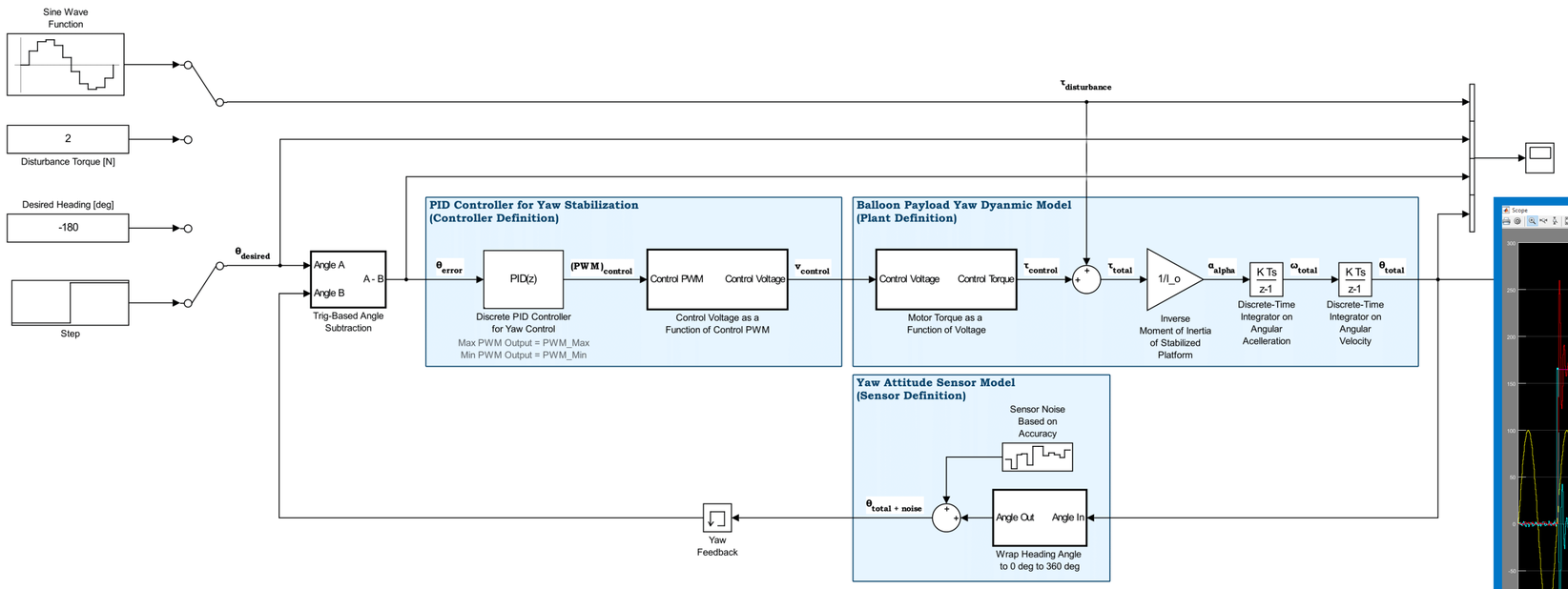


Brushless Gimbal Motor with Slip Ring for Continuous Yaw Rotation



Design Overview & Features:

- Attitude state estimation using 9-DOF IMU + GPS & Quaternion-Based Extended Kalman Filter Algorithm
- Continuous yaw stabilization and control achieved using single axis brushless gimbal setup within clear payload container
- Proposed PID control regime on yaw angle attitude feedback
- Model-based simulation and control law development in MATLAB/Simulink



Model-Based Simulation & Controller Design in MATLAB/Simulink

Control Law Formulation:

$$\tau_C = K_P\theta_e + K_I\int_{t_0}^{t_f}\theta_e dt + K_D\dot{\theta}_e$$

Acknowledgements:

Project Advisor/Mentor: Dr. Thomas Kelly
Additional Consulted Professors: Dr. James Richard Forbes (Univ. of Michigan),Dr. John Piccirillo
Supporting Organizations: Office of The Vice President for Research and Economic Development, Honors College, College of Engineering, The Space Hardware Club

Space Hardware Club
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