

AA279C: Spacecraft Attitude Determination and Control



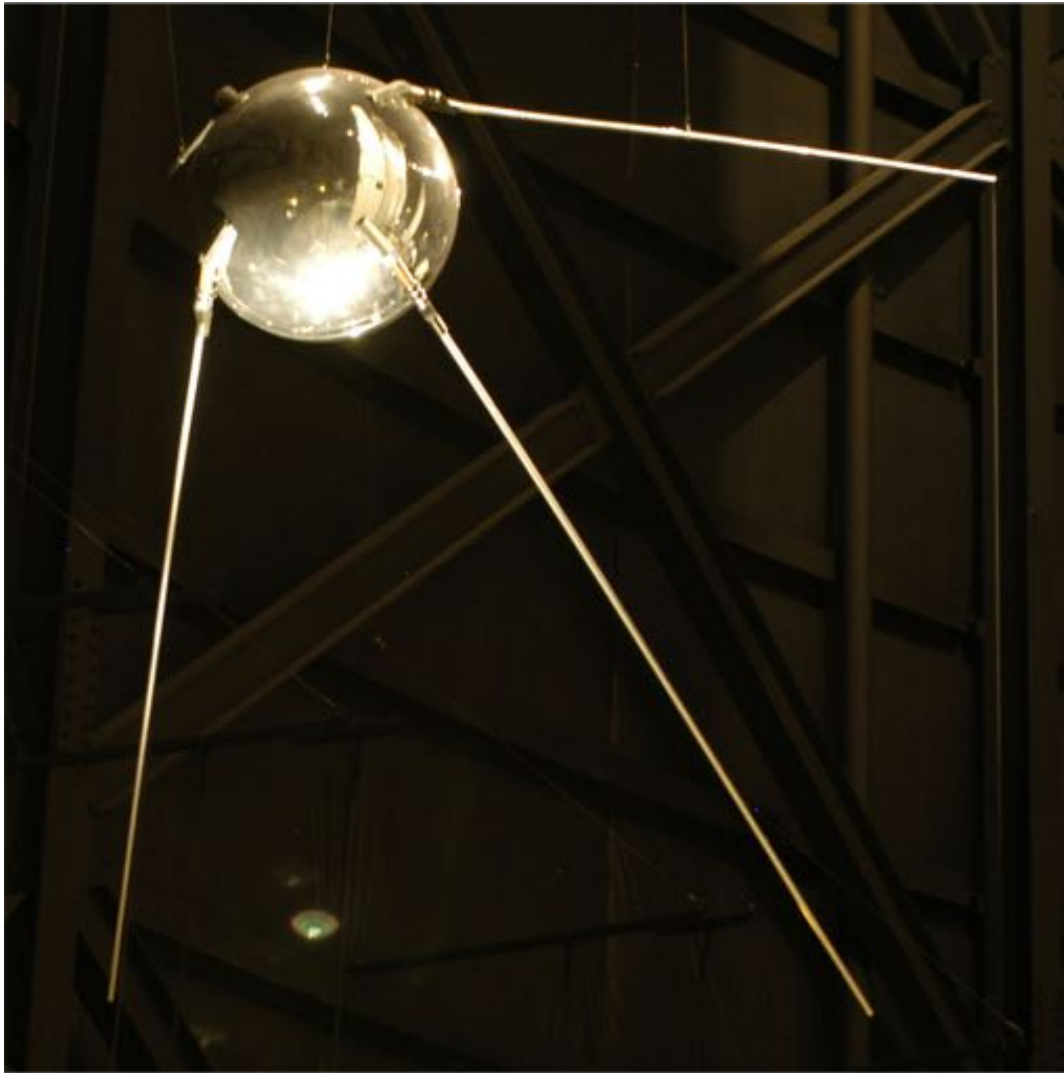
Spring 2018
Zac Manchester

Why We Care About This Stuff

- Attitude determination and control is one of the core disciplines within spacecraft engineering.
- Almost all spacecraft have to address the following questions:
 - Where does it need to point?
 - How well does it need to hold attitude?
- Attitude is intimately tied to all other spacecraft functions:
 - Power
 - Thermal
 - Propulsion
 - Telemetry & Command
 - Payload



A Brief History of Attitude...



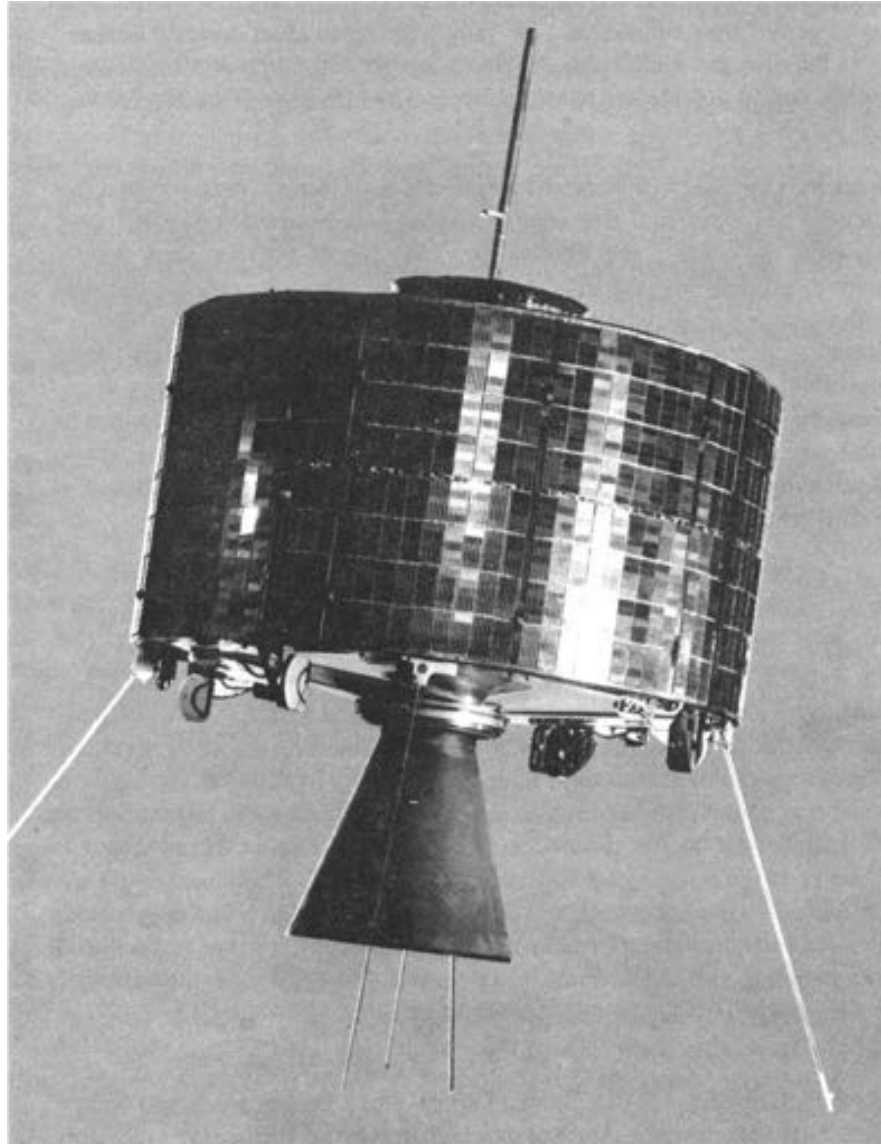
Sputnik - 1957

A Brief History of Attitude...



Explorer 1 - 1958

A Brief History of Attitude...



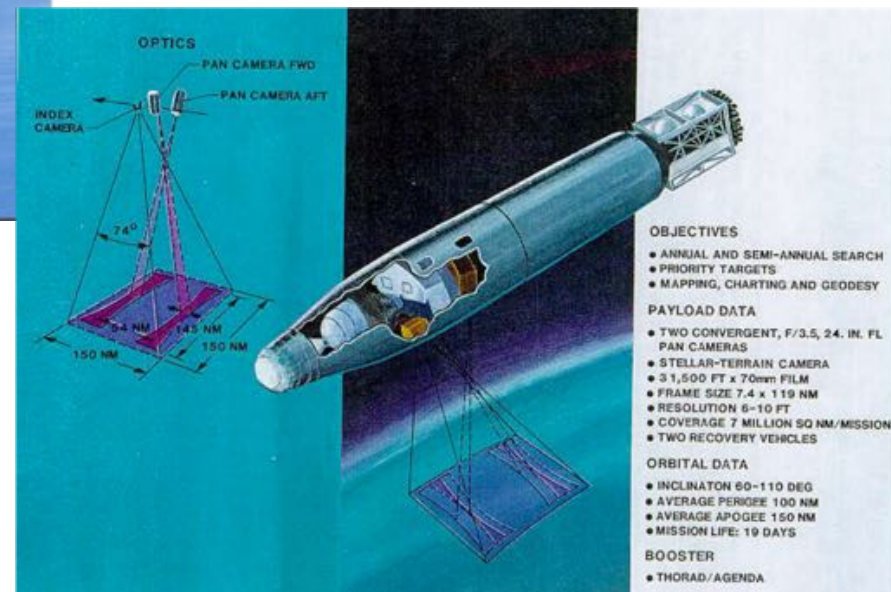
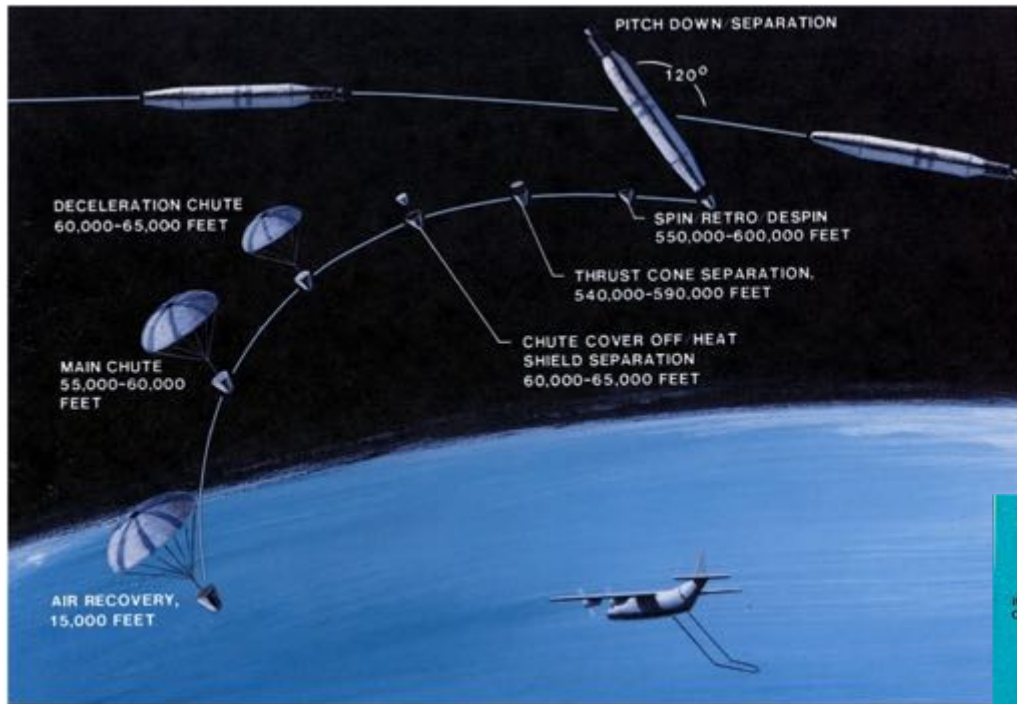
Syncom - 1963

A Brief History of Attitude...



TACSAT 1 - 1969

A Brief History of Attitude...



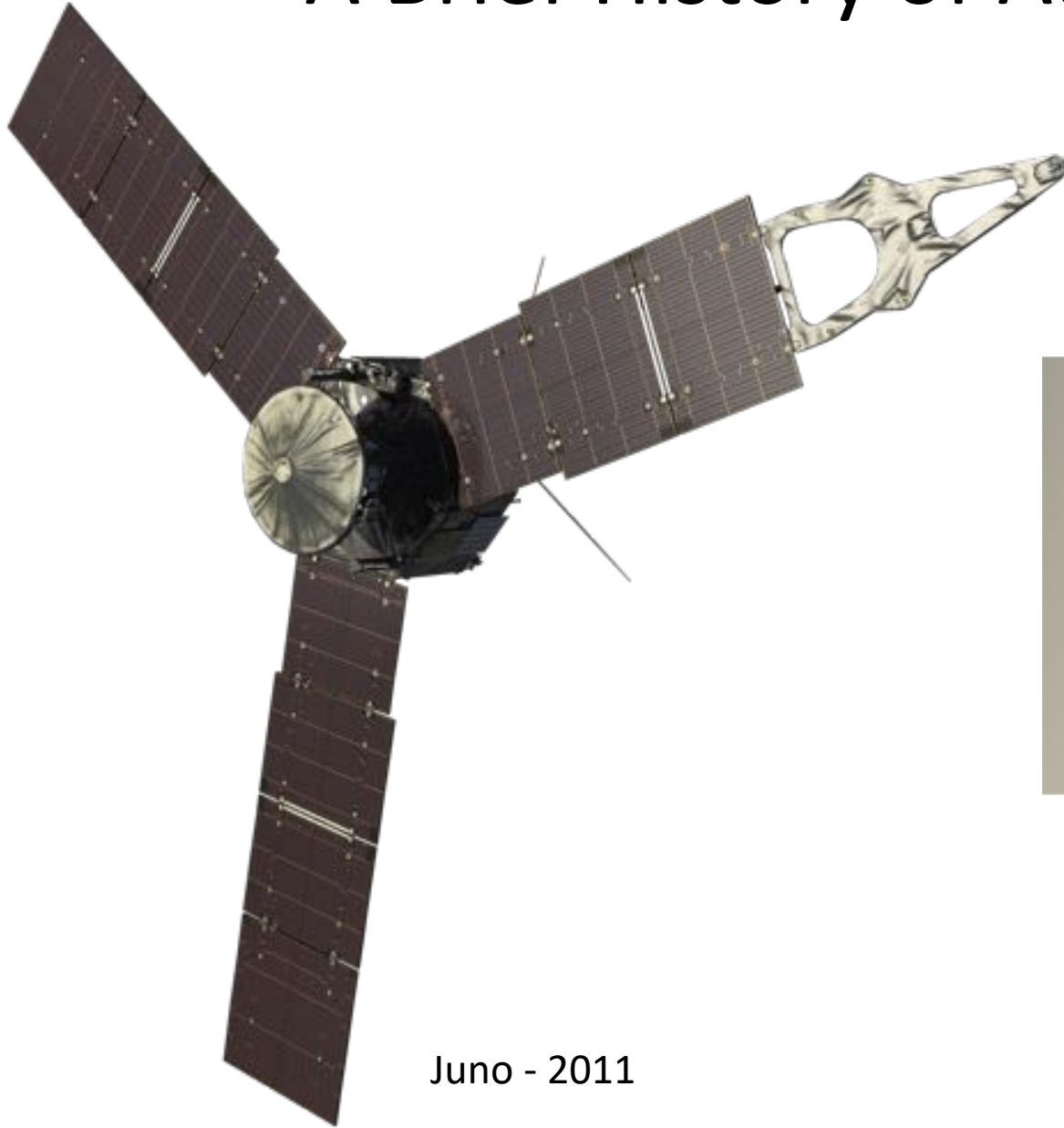
Discoverer 2 (Corona) - 1959

A Brief History of Attitude...

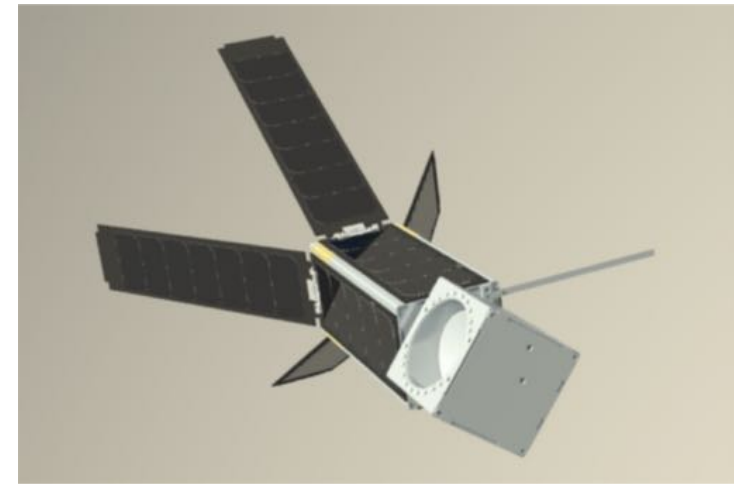


Intelsat 5 - 1980

A Brief History of Attitude...



Juno - 2011



MicroMAS 2 - 2018

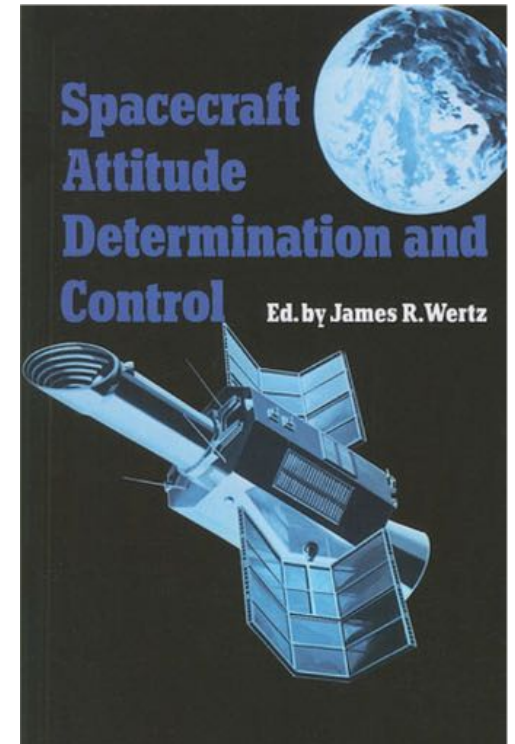
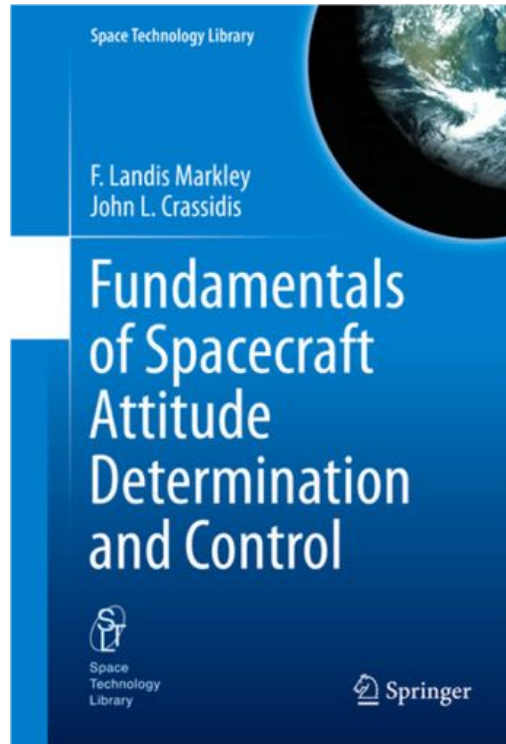
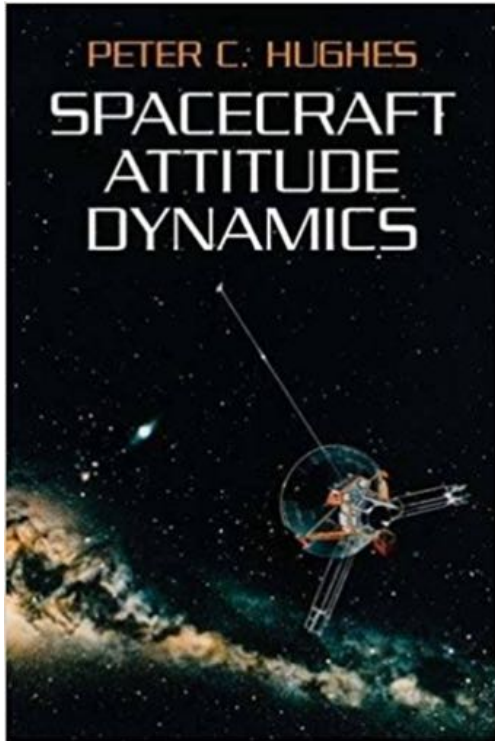
Rough Topic Schedule

1. Attitude parameterizations and the $SO(3)$ group
2. Rigid body and gyrostad dynamics
3. Damping and environmental perturbations
4. Spinning spacecraft and stability
5. Attitude determination: sensor measurements and TRIAD
6. Attitude determination: Whaba's problem and solution methods
7. Attitude determination: Kalman filters
8. Attitude control: passive solutions
9. Attitude control: feedback control
10. Advanced topics

Project and Grading

- Grading will be 40% based on participation and homework and 60% based on the course project.
- Each homework will analyze some aspect of the ADCS design for a spacecraft of your choice
- I will give you feedback on each homework.
- The final project will be a compilation of the analysis from all of the homework assignments.
- No exams.

Books



First Assignment

Think about the spacecraft mission you would like to analyze for your project. You should be able to specify the following information:

1. An Orbit
2. A Target attitude
3. An Attitude parameterization to use
4. Two or more attitude sensors
5. Two or more attitude actuators

Orbit	Target Attitude	Parameterization	Sensors	Actuators
LEO	Earth Pointing	Direction Cosine Matrix	Gyros	Thrusters
MEO	Sun Pointing	Euler Axis and Angle	Magnetometers	Magnetorquers
GEO	Inertial Pointing	Quaternions	Star Trackers	Reaction Wheels
GTO	Angles-Only	Gibbs Vector	Earth Sensor	Momentum Wheel
HEO	Pose Estimation	Euler Angles	Sun Sensor	Gravity Gradient Aerodynamic Drag