

Spacecraft Attitude Dynamics

ASTE586 2025

Lecturer, Dr. Troy Goodson

Welcome to ASTE586, Spacecraft Attitude Dynamics. My contact information may be found at the course's DEN site under 'Instructor'.

Feel free to send me email messages, but please only call my home before 10 pm. Contact me with any questions you have about class work, assignments, or personal concerns about your progress in the course. Outside of this class, I work at the Jet Propulsion Laboratory as a navigator.

Course Aims & Objectives

This is a first-course on spacecraft attitude dynamics, although the treatment is at the graduate level. We're going to try and stay away from most controls-related topics.

- **Preliminaries:** reference frames, coordinate systems, rotations, quaternions
- **Kinematics & Dynamics:** Coriolis effect, yo-yo despin
- **Stability of motion:** polhodes; body cone & space cone
- **Spinning spacecraft:** large angular deflections, energy dissipation, nutation dampers
- **Dual-spin spacecraft:** gyrostats, reaction wheels, thrusting maneuvers
- **Environmental & disturbance torques:** Earth's magnetic field, radiation torque
- **Gravity gradient and momentum bias s/c:** gravitational torque, damping, effects of slow spin

Grading Policy

Each homework is graded on a four-point scale, primarily for Doing It Right versus Getting the Right Answer. I don't give extensions on the homework.

Homework turned in late is reduced one point in the grade. The homework and computer project work are considered as a whole to produce the 'homework+project' grade. Exams are graded on whether you are using valid techniques to solve the problems in addition to whether or not you solve them. Exams will indicate how many points each part of each problem is worth.

homework/project 30%, midterm 30%, final 40%

Requirements

There is one computer project in this course in addition to the midterm and the final examination. Homework will be assigned each week.

The first two parts of the four-part computer project have deadlines, the remainder don't. The penalty for turning in either of these first two parts late is equivalent to 1% of the overall grade in the course. The penalty for turning in the final report of the computer project late is equivalent to 2% of the overall grade.

References

These books review the topics covered in this course and provide more detail in some areas. As we go along, I'll let you know which one I think is a good reference for whichever topic we're discussing. The book by Hughes is being printed by Dover (ISBN 0486439259)

Spacecraft Attitude Dynamics, Peter C. Hughes
Introduction to Space Dynamics, William Tyrrell Thomson
Spacecraft Attitude Dynamics and Control, Vladimir A. Chobotov
Spacecraft Dynamics, Thomas R. Kane, et. al.
Modern Spacecraft Dynamics & Control, Marshall H. Kaplan
Nonlinear Systems, Hassan K. Khalil

