Spacecraft Attitude Dynamics

ASTE586
Lecturer Dr. Troy Goodson
Spring 2011

Welcome to ASTE586, Spacecraft Attitude Dynamics. My home phone number is 626-277-9682. My home email address is `Troy_Goodson@iname.com`.

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 for the GRAIL mission to the Moon.

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, Chasle's theorem, 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

I grade homework on how correctly you apply what we discussed in class with less regard to whether the overall answer is correct or not. Each homework is graded on a four-point scale.

I don't give extensions on the homework. Homework turned in late is reduced one unit in the grade. However, the important thing is that you do the homework and turn it in, even if it is late.

I use the computed homework grade average as a *guide* in my overall assessment of how you actually performed in attempting to solve the homework problems. I consider this alongside your performance on the computer project 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 be labelled to indicate how many points each part of each problem is worth.

Requirements

There is one computer project in this course, due April 21, in addition to the midterm (March 10) and the final examination (May 5). Homework will be assigned each week. Grading: homework/project 30%, midterm 30%, final 40%.

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
Spacecraft Attitude Dynamics and Control, Vladimir A. Chobotov
Spacecraft Dynamics, Thomas R. Kane, et. al.
Modern Spacecraft Dynamcis & Control, Marshall H. Kaplan
Advanced Engineering Dynamics, Jerry H. Ginsberg
Nonlinear Systems, Hassan K. Khalil