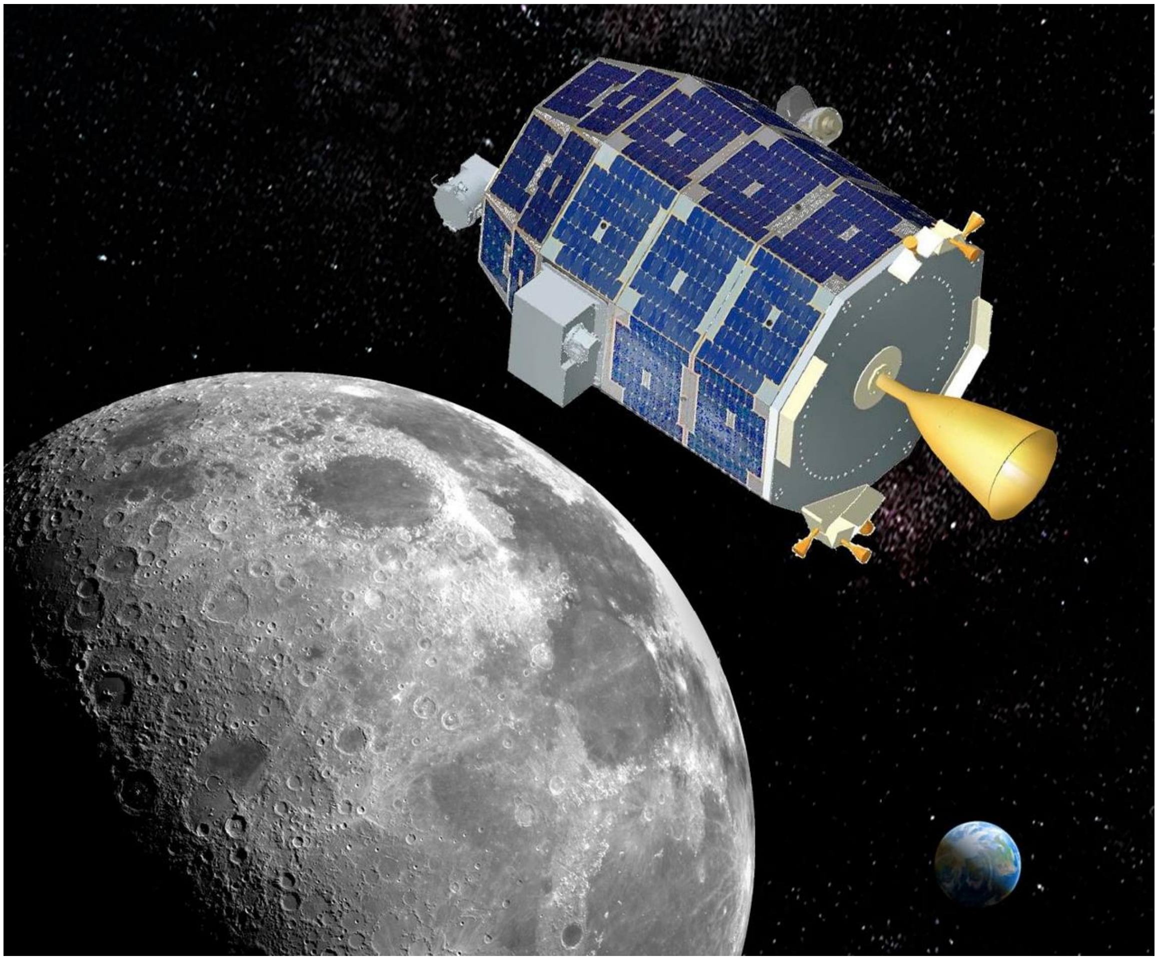
AE 245 – Spacecraft Dynamics and Control



Instructor Info	Dr. Sean Swei NASA Ames Research Center (650) 604-0314 (O) Seanswei@gmail.com Fall 2015
Credit	3 units
Class Days / Time	M 18:00 – 20:45
Classroom	Engr. CL 222
Prerequisites	"C-" or better in Math32 & Phys50
Co-requisite	Engr100W
Textbook	M.J. Sidi, Spacecraft Dynamics and Control: A Practical Engineering Approach, John Wiley & Sons Class notes

Additional References

V.A. Chobotov, *Spacecraft Attitude Dynamics and Control*, Krieger Publishing Company
A.E. Bryson, Jr., *Control of Spacecraft and Aircraft*, Princeton University Press
Bong Wie, *Space Vehicle Dynamics and Control*, AIAA
Ogata, K., *Modern Control Engineering*, Prentice Hall

Description

Rigid body dynamics review. Attitude kinematical representation. Development and solution of general equations of motion. Single and dual-spin, zero and biased-momentum spacecraft. Control system design strategies. Common torque elements. Computer simulations.

The contents of this course include:

- Development of rigid body equations of motion.
- Flexible modes and eigen analysis.
- Spin stability analysis.
- Stability properties of matrix-second-order systems.
- Modeling of flexible space structures.
- Spacecraft attitude control and stabilization.
- Application of modern control theory.

Goals The goals of this course are to:

- Introduce the spacecraft motions and how these motions can be controlled.
- Provide the fundamental background in the analysis of flexible space structures.
- Analyze and synthesize the control systems using modern control techniques.

Learning Objectives

Upon completion of this course, students should be able to:

- Derive equations of motion for rigid body space vehicles
- Solve eigenvalue/eigenvector problems
- Use matrix-second-order representation to describe space structure dynamics
- Analyze rigid body and flexible modes
- Design a stabilizing controller for precision positioning systems
- Describe and discuss various design methodologies and their trade-offs.

GRADING: Grading is based on the following:

- Homework: 30%
- Mid-term: 30%
- Final: 40%

APPROXIMATE WEEKLY SCHEDULE:

Week	Lecture Topic(s)
01	Introduction
02	Rigid body dynamics
03	Attitude dynamics & kinematics: Quaternions
04	State-space representation. Feedback control systems
05	System analysis in time & frequency domain
06	Gravity gradient stabilization
07	Spin stabilization
08	Quaternions-based attitude maneuvers
09	Mid-term exam
10	Reaction wheel (RW) dynamics
11	Sun safe controller design
12	Reaction control system (RCS): Thruster dynamics
13	RCS attitude control
14	Application of advanced control techniques
15	Structural dynamics & liquid sloshing
16	Summary and review

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