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
Aerospace Engineering

Dr. Sean Swei

AE 245 – Spacecraft Dynamics and Control

Additional References
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

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.
Aerospace Engineering

**AE 245 – Spacecraft Dynamics and Control**

**Grading:**
Grading is based on the following:
- Homework: 30%
- Mid-term: 30%
- Final: 40%

**Approximate Weekly Schedule:**

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<th>Week</th>
<th>Lecture Topic(s)</th>
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<tr>
<td>01</td>
<td>Introduction</td>
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<td>02</td>
<td>Rigid body dynamics</td>
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<td>03</td>
<td>Attitude dynamics &amp; kinematics: Quaternions</td>
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<td>04</td>
<td>State-space representation, Feedback control systems</td>
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<td>05</td>
<td>System analysis in time &amp; frequency domain</td>
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<td>06</td>
<td>Gravity gradient stabilization</td>
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<td>07</td>
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<td>Quaternions-based attitude maneuvers</td>
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<td>09</td>
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<td>Reaction wheel (RW) dynamics</td>
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<td>Sun safe controller design</td>
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<td>12</td>
<td>Reaction control system (RCS): Thruster dynamics</td>
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<td>RCS attitude control</td>
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<td>Application of advanced control techniques</td>
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<td>Structural dynamics &amp; liquid sloshing</td>
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<td>16</td>
<td>Summary and review</td>
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