MAE 6340 Spacecraft Attitude Control
Fall Semester, 2016

Instructor: Dr. Rees Fullmer, Dept. Mechanical and Aerospace Engineering, Room EL419A.
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Text: Fundamentals of Spacecraft Attitude Determination and Control, F. Markley, J. Crassidis, Springer, 2014, ISBN 978-1-4939-0801-1

References:

Much of the out-of-text material for this class can be found in Spacecraft Dynamics and Control, M. Sidi, Cambridge Aerospace Series, 1997, ISBN 0-521-55072-6

A highly recommended text is Space Vehicle Dynamics and Control, Bong Wie, AIAA Education Series, 1998. ISBN 10: 1-56347-261-9, ISBN 13: 987-1-56347-261-9

The details of quaternions and rotations are described in great detail in Quaternions and Rotation Sequences: A Primer with Applications to Orbits, Aerospace and Virtual Reality, J. B. Kuipers, 1999, ISBN 0-691-10298-8.

Another useful book, despite its use of Vectricies, is Spacecraft Attitude Dynamics, Peter C. Hughes, Dover Books on Engineering.

The very dated but extensive and useful book Spacecraft Attitude Determination and Control **,** James R. Wertz (Editor) 1978**,** ISBN 90-277-1204-2

Grading: Class grading will be based on homework and projects. Projects can be considered as open-ended design problems, with the grades reflecting the depth of the study as well as its presentation. Electronic submissions will be required, with significant penalties assessed for late submission. A final portfolio is required at the end of the semester.

Collaboration: No collaboration or teaming on code development will be permitted. Discussion with, but not relying on, the instructor and other students is encouraged.

Projects: Projects will require the use of MATLAB/Simulink package. Project reports are required to be professionally written, with an introduction and overview, a description of the basic fundamental model, design, or analysis. Finally the results, including properly labeled plots, must be presented. The actual code should be included in the appendix. Several informal teaching sessions will be provided for students interested in improving programming skills in Matlab-Simulink.

MATLAB/Simulink tutorials will be provided several times during the semester as requested by the students.

MAE/ECE 6345, Spacecraft Attitude Control Applications will continue Spring 2017, with a focus on attitude determination, sensors, mission operations and implementation.

Lecture	Date	Reading	Topics
1	29-Aug		ADCS systems overview
2	31-Aug		Matlab and Simulink review
3	2-Sep	2.4-5	Vectors and frames
	5-Sep		Labor Day: No class
4	7-Sep	2.9	Rotations
5	9-Sep	2.6	Useful reference frames
6	12-Sep		The quaternion as a rotation
7	14-Sep	2.7	Quaternion properties
8	16-Sep	2.8-10	Attitude representations
9	19-Sep		Review
10	21-Sep	3.1-2	Attitude kinematics
11	23-Sep	3.3.1-2	Rigid body dynamics
12	26-Sep	3.3.3-4	Dynamics of a spinning spacecraft
13	28-Sep	3.3.5-6	Internal and external torques
14	30-Sep	3.3.8	Dynamics of an earth pointing spacecraft
15	3-Oct		Review
16	5-Oct	E2	Review of classical controls 1
17	7-Oct	E2	Review of classical controls 2
18	10-Oct		Review of state space controls
19	12-Oct		Single DOF Hubble Space Telescope
20	14-Oct	Wie	Tracking, Internal models, trajectories
21	17-Oct		3 DOF PID control of spacecraft
22	19-Oct		Review
23	20-Oct		Review
	21-Oct		Fall break: No class
24	24-Oct	7.2	Spacecraft Regulation
25	26-Oct	7.3.1	Spacecraft maneuvers
26	28-Oct		Maneuver example
27	31-Oct	7.4	Thruster attitude control
28	2-Nov	7.5	Magnetic attitude control
29	4-Nov	7.7	Sampex mission example 1
30	7-Nov	7.7	Sampex mission example 2
31	9-Nov		Review
32-42	11-Nov to 9-Dec		Specific topics of interest to the class
			Advanced control strategies Spin stabilized mission Bias momentum mission Design for Flexible body models Design for Multiple DOF bodies Rendezvous and docking issues