

Spacecraft Attitude Dynamics

EAS6939 – Fall 2021

Course Objectives

To rigorously develop the concepts, mathematical procedures, and methods associated with defining, determining, and controlling the attitude of a spacecraft. Specifically, the student will develop the theoretical background necessary to pursue research in the field of Spacecraft Attitude Dynamics.

Prerequisites

A fundamental knowledge of vector dynamics, matrix algebra, and computer programming skills.

Recommended Texts

- *Spacecraft Attitude Dynamics*, by Peter C. Hughes
- *Fundamentals of Spacecraft Attitude Determination and Control*, F. Landis Markley and John L. Crassidis
- *Analytical Mechanics of Space Systems*, by Hanspeter Schaub and John Junkins
- *Spacecraft Dynamics and Control: A Practical Engineering Approach*, by Marcel J. Sidi
- Archival papers (Shuster)
- *Spacecraft Attitude Determination and Control*, Edited by James R. Wertz
- *Spacecraft Attitude Dynamics and Control*, by Vladimir A. Chobotov
- *Space Vehicle Dynamics and Control*, by Bong Wie

Instructor:

Norman Fitz-Coy; 206 MAE-A; 352-392-1029; nfc@ufl.edu
Office hours: Open door policy in effect; official: **TBD**

Class Schedule & Grading Policy

Lectures: 8:30-9:20 MWF (CSE 122)
Homework/Project 30%
Exams 70%

Homework will be assigned weekly. A project will be assigned around mid-semester, with a required written final report and oral presentation.

Topics Covered

- Attitude variables (direction cosines, Euler angles, Euler parameters, Rodrigues parameters, Modified Rodrigues parameters)
- Kinematics of angular motion
- Dynamics of free rigid bodies
- Environmental forces and torques
- Effects of energy dissipation on externally torque-free attitude motion
- Stabilization techniques (spin stabilization, dual-spin stabilization, gravity gradient stabilization)
- Attitude determination techniques
- Active attitude control devices and strategies

Class Attendance & Student Behavior

Class attendance is not mandatory but students are strongly encouraged to attend all lectures. When in class, however, **ALL** personal communication devices (cell phones, iPads, pagers, etc.) must be turned off (or in the silent mode); each disturbance will result in 5 points being deducted from your overall score.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Conduct Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Other Student Resources

University Counseling Center - (352) 392-1575 - <http://www.counsel.ufl.edu/default.asp>

Mental Health Services - (352) 392-1171 - <http://www.health.ufl.edu/shcc/smhs.htm>

Alachua County Crisis Center - (352) 264-6789

Campus Resources: Health and Wellness

U Matter, We Care: If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu>, and 352-392-1575; and the University Police Department: 352-392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence: If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS): Student Health Care Center, 352-392-1161.

University Police Department: (352) 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>

Academic Resources

E-learning technical support, (352) 392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml> .

Career Resource Center, Reitz Union: (352) 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>

Library Support, Various ways to receive assistance with respect to using the libraries or finding resources. <http://cms.uflib.ufl.edu/ask>

Teaching Center, Broward Hall, (352) 392-2010 or (352) 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>

Writing Studio, 302 Tigert Hall, (352) 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>

Student Complaints Campus: <http://care.dso.ufl.edu>, <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>