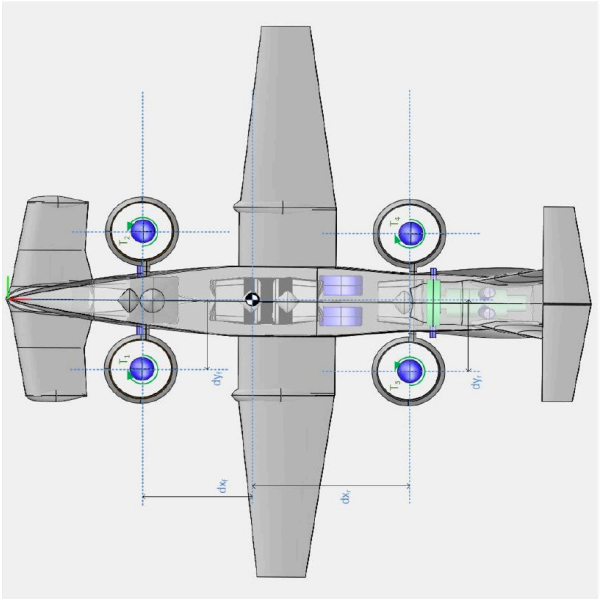
San Jose State University
Department of Aerospace Engineering

AE 173 – Unmanned Air Vehicle (UAV) Design

Fall 2020



INSTRUCTOR: Dr. Nick Cramer
NASA Ames Research Center
(810) 874-0562 (C)
Cram9030@gmail.com

TIME/ROOM: TuTh 04:30 – 05:45pm Online
OFFICE HOUR: TuTh 05:45 – 07:00pm Online

PRE/CO-REQUISITE: Basic knowledge of flight dynamics and controls, and familiarity of simulation tools, such as MATLAB/Simulink.

TEXTBOOK: Class Notes

R.W. Beard, T.W. McLain, *Small Unmanned Aircraft: Theory and Practice,* Princeton University Press, 2012

DESCRIPTION: Introduction of unmanned aircraft systems (UAS) and relevant design and operation considerations. Vehicle dynamics and flight controls. UAS flight path planning and optimization. Computer simulations.

GOALS: The goals of this course are to study:

- Unmanned air vehicle (UAV) design and analysis for flight missions
- UAV models
- Flight control design utilizing successive loop closure
- UAV sensors and actuators
- Advanced UAV configurations

GENERAL EXPECTATIONS: Students are expected to work on projects of their choice. In addition, they are encouraged to dovetail their own graduate research with the class projects.

ONLINE CLASS EXPECTATIONS:

- The lecture period of the classes will be recorded for later watching.
- There will typically be an unrecorded Q&A period for students who want to ask questions that are relevant to the entire class but do not want to be recorded.
- The lecturer will always have their video on. To respect different peoples internet bandwidth video is not expected for everyone else.
- If you want to verbalize a question raise your hand and turn on your video.
- Most of the lecture interaction will be through the chat box. I expect and encourage cross talk and engagement in chat. Please keep the chat discussion at least loosely related to the class.
- The live lectures are a social experience but the class is fundamentally educational. There is time for fun and time for questions please distinguish the two.
- This is a learning experience for all of us and these **expectation are subject to change and updates** as we learn about the class culture.

GRADING: Grading is based on the following:

- **Homework: 30%** (due before the class, ***no late HW!)***
- **Project: 70%**
  - Literature survey: 10%
  - Mid-term reviews: 20%
  - Final presentation/report: 40%

GRADING SCALE: A+: 100 – 97%; A: 96.9 – 93%; A-: 92.9 – 90%; B+: 89.9 – 87%; B: 86.9 – 83%; B-: 82.9 – 80%; C+: 79.9 – 77%; C: 76.9 – 73%; C-: 72.9 – 70%; D+: 69.9 – 67%; D: 66.9 – 63%; D-: 62.9 – 60%; F: < 59.9%.

TOPICS TO BE COVERED:

Item	Lecture Topic(s)
01	Introduction
02	Euler angles and coordinate transformation ▪ Kinematics ▪ Quaterions
03	Derivation of equations of motion ▪ Linear models ▪ Quadcopter dynamics
04	Avionic sensors – Data fusion ▪ IMU/GPS ▪ LIDAR/RADAR
05	Flight control design ▪ Inner-loop ▪ Successive loop closure
06	System identification ▪ Multi-rotor vehicles ▪ Frequency domain
07	**Mid-Term Project Reviews**
08	Guidance control design ▪ Outer-loop ▪ Waypoint following ▪ Trajectory/path planning
09	State-Estimation ▪ Dynamic observer design ▪ Kalman filter
10	Summary & future application
11	Project presentation