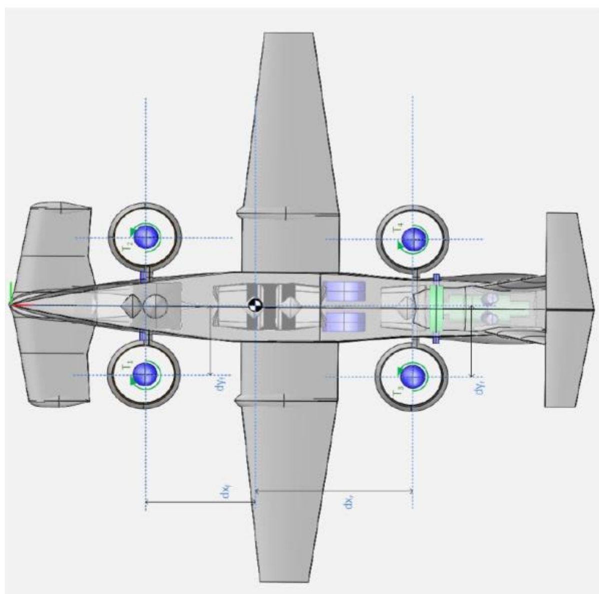
San Jose State University
Department of Aerospace Engineering

AE 173 – Unmanned Air Vehicle (UAV) Design

Fall 2019



INSTRUCTOR: Dr. Sean Swei
NASA Ames Research Center
(650) 604-0314 (O)
seanswei@gmail.com

TIME/ROOM: MoWe 04:30 – 05:45pm Eng. 340
OFFICE HOUR: MoWe 03:45 – 04:30pm Eng. 272

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

REFERENCES: K.P. Valavanis, G.J. Vachtsevanos, *Hankdbook of Unmanned Aerial Vehicles*, Springer Link, 2015. Online book: https://link.springer.com/referencework/10.1007%2F978-90-481-9707-1

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

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.

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