

San Jose State University
Department of Aerospace Engineering

AE 173 – Unmanned Air Vehicle (UAV) Design

Fall 2018



INSTRUCTOR: Dr. Sean Swei
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TIME/ROOM: MoWe 04:30 – 05:45pm Eng. 164
OFFICE HOUR: MoWe 05:45 – 06:30pm 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, *Handbook 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: 15%
 - Mid-term review: 15%
 - 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:

<u>Item</u>	<u>Lecture Topic(s)</u>
01	Introduction
02	Euler angles and coordinate transformation <ul style="list-style-type: none">▪ Kinematics▪ Quaterions
03	Derivation of equations of motion <ul style="list-style-type: none">▪ Linear models▪ Quadcopter dynamics
04	Flight control design <ul style="list-style-type: none">▪ Inner-loop▪ Successive loop closure
05	Mid-Term Project Review
06	Guidance control design <ul style="list-style-type: none">▪ Outer-loop▪ Waypoint following▪ Trajectory/path planning
07	Avionic sensors – Data fusion <ul style="list-style-type: none">▪ IMU/GPS▪ LIDAR/RADAR
08	State-Estimation <ul style="list-style-type: none">▪ Dynamic observer design▪ Kalman filter
09	Summary & future application
10	Project presentation