AER1216: Fundamentals of UAVs

Projects List (Winter 2016)

Version R2: Jan 31, 2016 (with Assignment)

1 Project

A course project accounts for 40% of the overall course evaluation. It is expected to be completed by each registered student working individually with a specified topic. The project topics are defined by the instructors based on lecturing coverage and research expertise. ALL students are encouraged to consult the Coordinator (Professor Liu, liu@utias.utoronto.ca) within the first 2 weeks to choose a proper topic. The progress of the course project and some details will be updated frequently, please check the site for updates. A tentative agenda provides some general guidelines

- (Jan. 15-29) Project topics and selection (in consultation with the Coordinator and instructors)
- (Feb. 05-26) Project proposal approved in discussion with instructors
- (Mar 04-Apr. 01) Project development
- (Apr. 15) Project report due, presentations, and poster

2 Project Topics (with Student assignment)

PART I: UAV AERODYNAMICS

1. Aerodynamic shape optimization of airfoils for high endurance. (Zingg) - A. Patel
2. Aerodynamic shape optimization of airfoils for long range. (Zingg) - E. Wong
3. Propeller design for a quad rotor (Lavoie) - S. Sudheesh B S Kumary
4. Simulations of a low Re airfoil with OpenFOAM. (Lavoie) (only computer savvy students need apply) - J. Zilli, K. Ni

PART II: UAV STRUCTURES

5. Topology optimization of a 2D wing structure (Steeves) - T. Chung
6. Mass estimation for a composite wing (Steeves) - J. Canton

PART III: UAV DYNAMICS AND CONTROL

7. quadrotor modeling related topics (Schoellig) - J. Tsang
   a) Develop realistic noise and disturbance model for quadrotor simulator
b) Motion capture system optimization

c) Planning feasible motions for quadrotor vehicles

8. quadrotor control related topics (Schoellig) - A. Zandieh
   a) Development of a safety controller to prevent crashes (flying into walls etc)
   b) Collision avoidance: Develop safety system to prevent crashes when flying multiple vehicles

9. V/TOL UAV Design and Control Survey (Liu) - X. Song

10. Flying Wing Altitude Control (Liu) - J. Cirtwill

PART IV: UAV NAVIGATION

11. 3D Receding Horizon Motion Planning on Evolving Map. (Waslander) - N. Lashba Raj
    For either fixed wing or rotorcraft UAVs, create a motion planning algorithm to avoid obstacles in a continuously updated map of the environment. Limit current map visibility to a fixed range and field of view of the sensors, and identify efficient strategies that can be updated in real time. Consider always planning a safe holding pattern, and demonstrate the algorithm on forest or urban environments.

12. Coverage planning for agriculture monitoring. (Waslander) - A. Ghorbanian
    For a collection of agricultural plots with obstacles and irregular boundaries, define coverage planning methods that minimize overlap and can vary sweep width. Incorporate user defined start and end points, curved boundaries, and account for wind effects. (Waslander)

13. Karman filtering of GNSS and inertial data for UAV pose estimation (Kelly) - L. Xiang

14. Vision-based navigation and obstacle avoidance using a monocular camera (Kelly) - J. King

PART V: UAV AUTONOMY (Barfoot, Daly, Urtasun)

15. State Estimation of Fixed-wing UAVs (survey) (Barfoot) - Y. Zhang

16. State Estimation of Rotor UAVs (survey) (Barfoot) - T. Teng

17. TBD (Daly) related to instrumentation - P. Abdelmalak

18. TBD (Daly) related to instrumentation - V. Malliga Jeevanantham

19. TBD (Urtasun) related to computer vision - P. Dixit

20. TBD (Urtasun) related to computer vision - P. Manohar Chandran

PART VI: UAV PERFORMANCE AND DESIGN

21. Design of a fixed wing UAV for long duration monitoring (Grant) - Y. Zhao, Y. Gajjar

22. Prediction of Quad-rotor performance including simplified inflow and propeller effects. (Grant) - N. Ewaschuk