CS 491/691: Special Topics in Robotics (Introduction to Aerial Robotics)

Course Information

- Monday, Wednesday 5.30PM – 6.45PM
- Place: PE105
- Office hours: 3:00pm-5:15pm Mondays and Wednesdays, please make an appointment via email before you come
- Instructor: Dr. Kostas Alexis
- Email: kalexis@unr.edu
- Phone: 775-682-6871
- Office: SEM 202
- course homepage: http://www.autonomousrobotslab.com/introduction-to-aerial-robotics.html

Course Description

This course aims to introduce students into the holistic design of autonomous aerial robots – from the mechatronic design to sensors and intelligence. The course contains modules on modeling and flight dynamics, state estimation, robot vision, Simultaneous Localization And Mapping and object detection, flight control systems, path planning for aerial robots, as well as multi-robot teaming. A semester-long student project helps to equip student with robot development skills.

Course Learning Outcomes

- Student Outcome 1: an ability to apply knowledge of computing, mathematics, science, and engineering.
    - students demonstrate an understanding of the process of developing an actual robot with autonomy levels sufficient for navigation.
- Student Outcome 3: an ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs, within realistic constraints specific to the field.
    - students demonstrate an understanding of the process of developing an actual robot with autonomy levels sufficient for navigation.
- Student Outcome 4: an ability to function effectively on multi-disciplinary teams.
    - students work in groups and will experience different roles (designer/implementer) with regards to their group work.
- Student Outcome 7: an ability to communicate effectively with a range of audiences.
    - students will work in groups on their projects and present their work to an audience which will grade them.
- Student Outcome 11: an ability to use current techniques, skills, and tools necessary for computing and engineering practice.
    - students will develop system design, algorithm design and implementation skills. Also, they gain practical knowledge on aspects of robotics development.

Primary Textbook

Course Lectures, online textbook, code examples and other such material at
http://www.autonomousrobotslab.com/introduction-to-aerial-robotics.html

Optional Textbook: R. Beard, and T. W. McLain, "Small Unmanned Aircraft: Theory and Practice", Princeton University Press.

Course Activities:

Lectures, a semester-long team-project, homework assignments, individual programming projects, one mid-term and one final examination.

Description of Course Requirements:

There will be one major semester-long project that students will have to address in teams. There will be approximately 4 homework assignments throughout the semester, and one project. The homework assignments are mostly coding problems in the field of state estimation, control and path planning.

Grading Criteria, Scale, and Standards:

- The final grade will be based on (Tentative, subject to change):

Section	491	691
Homework	15%	15%
Project	40%	40%
Midterm Exam	20%	20%
Final Exam	25%	25%

- Letter grades will be based on a 10 point scale ([90, 100] = A, [80, 90) = B, ...). Plus/minus grading will be used. For more details, see the NSHE Grading Policy.

Topics Outline:

The course is organized around the following topics:

- Modeling and Flight Dynamics: Coordinate transformations and dynamic modeling of micro aerial vehicles.
- State Estimation for Aerial Robots: Sensor fusion techniques to estimate the vehicle pose.
- Robot Vision, SLAM and Detection: Specialization on onboard vision techniques for Simultaneous Localization And Mapping (SLAM) and object detection.
- Flight Control Systems: Attitude and position control for micro aerial vehicles.
- Path Planning for Aerial Robots: Collision-free and autonomous exploration/inspection planning.
- Multi-robot Systems and Swarming: Collaborative aerial robotics for coverage applications.

Statement on Academic Dishonesty:

"Cheating, plagiarism or otherwise obtaining grades under false pretenses constitute academic dishonesty according to the code of this university. Academic dishonesty will not be tolerated and penalties can include canceling a student's enrollment without a grade, giving an F for the course or for the assignment. For more details, see the University of Nevada, Reno General Catalog."

Statement of Disability Services:

"Any student with a disability needing academic adjustments or accommodations is requested to speak with the Disability Resource Center (Pennington Student Achievement Center, Suite 230) as soon as possible to arrange for appropriate accommodations."

Statement on Audio and Video Recording:

"Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded."