Introduction to Unmanned Vehicle Systems
Fall 2020

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Section Information:

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE 5378-001 LEC</td>
<td>INTRO TO UNMANNED VEHICLE SYST</td>
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<td>MAE 4378-001 LEC</td>
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<td>EE 4378-001 LEC</td>
<td>INTRO UNMANNED VEHICLES</td>
</tr>
<tr>
<td>CSE 4378-001 LEC</td>
<td>INTRO TO UNMANNED VEHICLE SYST</td>
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<td>CSE 5383-001 LEC</td>
<td>INTRO-UNMANNED VEHICLE SYSTEMS</td>
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<td>IE 4378-001 LEC</td>
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Time and Place of Class Meetings: Mon. – Wed. 4:00 PM to 5:20 PM; On-Line Synchronous

Description of Course Content: Introduction to UVS (Unmanned Vehicle Systems) such as UAS (Unmanned Aircraft Systems), UGS (Unmanned Ground System) and UMS (Unmanned Maritime System), their history, missions, capabilities, types, configurations, subsystems, and the disciplines needed for UVS development and operation. UVS missions could include student competitions sponsored by various technical organizations. This course is team-taught by engineering faculty. Prerequisite: Admission to a professional engineering or science program.

Student Learning Outcomes: This course is designed to provide students with a general overview of technologies and engineering methods used to develop and deploy Unmanned Vehicle Systems. This course explicitly takes a multi-disciplinary approach to presenting unmanned systems. The class will be team-taught with faculty from the Electrical, Computer Science, Mechanical, Aerospace, and Industrial Engineering Departments. This course is designed to present the student with materials that would typically fall outside his/her main area of study challenging the student to explore the inherently multi-disciplinary nature of today’s complex engineered systems. This course is the first course of a common two course sequence that forms the foundation of an Undergraduate and Graduate UVS Certificate program offered in the Electrical Engineering, Computer Science Engineering, Mechanical and Aerospace Engineering, and Industrial and Manufacturing Systems Engineering Departments.
By the end of the course, you should be able to:

- Describe the common types, missions and roles of Unmanned Vehicle Systems
- Identify and list the common subsystems and technologies deployed in UVS
- Use programming toolsets to model unmanned systems
- Discuss the various types of sensors used within UVS and describe suitable sensor fusion methods
- Describe the common methods used by UVS to perform Guidance, Navigation, & Control functions
- Describe the approaches and technologies used to create UVS man/machine interfaces

Course Schedule.

The following is a list of topics to be covered in this course:

**Introduction**: Class objectives, introduction to the types, history, and missions & roles of unmanned vehicle systems.

**Matlab/Simulink**: An introduction to the Matlab/Simulink toolsets with examples relevant to the development of unmanned vehicle systems.

**Mobile Platforms**: These classes will introduce vehicle design, system dynamics, and vehicle structures.

**Guidance, Navigation, & Control**: Topics relating to vehicle guidance and path planning, navigation, vehicle control, and mission planning will be presented.

**Sensors**: Classes will provide an introduction to the classes of sensors typically found on unmanned vehicle systems. Sensors used for mobility platform control and those utilized within payloads will be discussed.

**Test 1 (in-class exam)**: Scheduled for the 8th week of class.

**Path Planning**: Classes will provide an introduction to automated path planning methods associated with unmanned vehicle systems.

**Sensor Fusion**: Techniques, like Kalman Filters, used to combine sensor inputs to create more robust estimates of environmental conditions and system states will be presented.

**Localization & Mapping**: Methods used to determine the vehicle’s position within a given reference frame and techniques used to map the UVS operational environment will be reviewed.

**Communications**: Topics relating to the creation and maintenance of communications channels within the UVS. Specific topics include: networks, protocols, security, and architectures.

**Autonomy**: An introduction into systems autonomy. Various autonomous vehicle control architectures will be presented and discussed.

**Human/Operator Interface**: Methods and technologies used to communicate the operator’s intent to the unmanned vehicle will be presented. Topics will include: data displays, mission input, and the man-mission interface.

**Integrative Infrastructure**: Methods, techniques, and tool used to effectively integrate complex electromechanical systems will be presented. Topics will include: computing architectures, common software, and modular hardware.

**Multi-Systems Coordination**: A discussion of potential collaboration of homogeneous and heterogeneous teams of UVS. Applications and methods will be discussed.

**Systems Engineering**: An introduction to the systems development lifecycle.

**Final Class**: This class will attempt to summarize and integrate the major themes in the course. The follow-on Unmanned Vehicle Systems Development course will be discussed.

**Test 2 (in-class exam)**: Taken at the official exam time associated with the class time during finals week.

The instructors for this course reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course.
Required Textbooks and Other Course Materials: There is no required Text for this course. Notes and supplemental materials will be provided by the course instructors.

Descriptions of major assignments and examinations: The will be two tests. The two exams will be taken in as a CANVAS Computer-based quiz. You will be required to us Respondus Lock-down Browser with a Webcam. The second in class exam will be taken during Finals Week at the official exam time assigned to the class.

Attendance: Attendance of the class is required. Each student is required to log into a TEAMS meeting at the scheduled time of the class and to actively participate. Quizzes over assigned reading material will be administered approximately once a week.

The U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients “begin attendance in a course.” UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via CANVAS. This date is reported to the Department of Education for federal financial aid recipients.

Other Requirements: Undergraduate Students must be accepted into the professional program within their home engineering department. Graduate students must be in good academic standing at the time of enrollment for the class. Degree Undergraduates seeking to obtain a UVS Certificate without pursuing a Masters degree, must be accepted into one of the departmental Graduate UVS Certificate programs.

Grading: The following items will be graded and used to determine the final class grade.

- Five or Six Homework Assignments  
  20%
- Test 1 – In class test  
  30%
- Test 2 – In class test  
  30%
- Class Participation / Quizzes  
  20%

The following scale will be used to assign class grades:

- A  90% - 100%
- B  80% - 89%
- C  70% - 79%
- D  60% - 69%
- F  less than 60%

Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels.

Grade Grievances: Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current University Catalog. For undergraduate courses, see http://catalog.uta.edu/academicregulations/grades/#undergraduatetext; for graduate courses, see http://catalog.uta.edu/academicregulations/grades/#graduatetext. For student complaints, see http://www.uta.edu/deanofstudents/student-complaints/index.php.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be
required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (http://wweb.uta.edu/aoa/fao/).

**Disability Accommodations:** UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including The Americans with Disabilities Act (ADA), The Americans with Disabilities Amendments Act (ADAAA), and Section 504 of the Rehabilitation Act. All instructors at UT Arlington are required by law to provide “reasonable accommodations” to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a letter certified by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

The Office for Students with Disabilities, (OSD) www.uta.edu/disability or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability.

Counseling and Psychological Services, (CAPS) www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

**Non-Discrimination Policy:** The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos.

**Title IX Policy:** The University of Texas at Arlington (“University”) is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.

**Academic Integrity:** Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

> I pledge, on my honor, to uphold UT Arlington’s tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

> I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System Regents’ Rule 50101, §2.2, suspected violations of university’s standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student’s suspension or expulsion from the University. Additional information is available at https://www.uta.edu/conduct/.

**Electronic Communication:** UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at http://www.uta.edu/oit/cs/email/mavmail.php.
Campus Carry: Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit http://www.uta.edu/news/info/campus-carry/

Student Feedback Survey: At the end of each term, students enrolled in face-to-face and online classes categorized as “lecture,” “seminar,” or “laboratory” are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student’s feedback via the SFS database is aggregated with that of other students enrolled in the course. Students’ anonymity will be protected to the extent that the law allows. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit http://www.uta.edu/sfs.

Final Review Week: For semester-long courses, a period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabus. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Students are encouraged to subscribe to the MavAlert system that will send information in case of an emergency to their cell phones or email accounts. Anyone can subscribe at https://mavalert.uta.edu/ or https://mavalert.uta.edu/register.php.

Student Support Services: UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at http://www.uta.edu/universitycollege/resources/index.php.

The IDEAS Center (2nd Floor of Central Library) offers free tutoring to all students with a focus on transfer students, sophomores, veterans and others undergoing a transition to UT Arlington. To schedule an appointment with a peer tutor or mentor email IDEAS@uta.edu or call (817) 272-6593.

The English Writing Center (411LIBR): The Writing Center Offers free tutoring in 20-, 40-, or 60-minute face-to-face and online sessions to all UTA students on any phase of their UTA coursework. Our hours are 9 am to 8 pm Mon.-Thurs., 9 am-3 pm Fri. and Noon-6 pm Sat. and Sun. Register and make appointments online at http://uta.mywconline.com. Classroom Visits, workshops, and specialized services for graduate students are also available. Please see www.uta.edu/owl for detailed information on all our programs and services.

The Library’s 2nd floor Academic Plaza offers students a central hub of support services, including IDEAS Center, University Advising Services, Transfer UTA and various college/school advising hours. Services are available during the library’s hours of operation. http://library.uta.edu/academic-plaza
**Technology Requirements**: This class will use the Canvas on-line class management system to post assignments, communicate to the class, and post class recordings. The Microsoft Teams meeting platform may be used for internet-based meetings. The Respondus Lockdown browser with webcam student monitoring will be used for computer-based tests. The class will also use the Matlab and Simulink applications throughout the class. Students are expected to download and install a version of Matlab and Simulink for their personal use (instructions to obtain this software is contained in a CANVAS course module for this class). Each student is expected to have access to a personal computer capable of accessing these internet-based services and running these applications. Personal computers will be required for on-line tests, quizzes, and exercises.

**Institution Information**
UTA students are encouraged to review the below institutional policies and informational sections and reach out to the specific office with any questions. To view this institutional information, please visit the Institutional Information page (https://resources.uta.edu/provost/course-related-info/institutional-policies.php) which includes the following policies among others:

- Drop Policy
- Disability Accommodations
- Title IX Policy
- Academic Integrity
- Student Feedback Survey
- Final Exam Schedule

**Mandatory Face Covering Policy**
All students and instructional staff are required to wear facial coverings while they are on campus, inside buildings and classrooms. Students that fail to comply with the facial covering requirement will be asked to leave the class session. If students need masks, they may obtain them at the Central Library, the E.H. Hereford University Center’s front desk or in their department. Students who refuse to wear a facial covering in class will be asked to leave the session by the instructor, and, if the student refuses to leave, they may be reported to UTA’s Office of Student Conduct.
Stop. Think. Protect Yourself. You Have Choices.

The safety and security of our campus is the responsibility of everyone in our community. Each of us has an obligation to be prepared to appropriately respond to threats to our campus, such as an active aggressor.

This graphic provides each member of the UTA community with information and options for responding to an active threat. These options are not chronological, but are designed to address dynamic situations. Assess the situation (your location, the location of the threat, type of threat, etc.), identify and weigh your options, develop a plan of action and commit to it.

### YOUR OPTIONS TO AN ACTIVE THREAT

#### You Have Choices!

<table>
<thead>
<tr>
<th>AVOID</th>
<th>DENY</th>
<th>DEFEND</th>
</tr>
</thead>
<tbody>
<tr>
<td>• AVOID the situation. Stay away from the area and campus.</td>
<td>• Know your exit and escape options.</td>
<td>• As a last resort, FIGHT for your life.</td>
</tr>
<tr>
<td>• If you can safely leave the area, RUN.</td>
<td>• If in a parking lot, get to your car and leave.</td>
<td>• Use physical force and any weapons available - fire extinguishers, books, chairs, belts, umbrellas, pens/scissors, hot coffee/drinks, trash cans, etc.</td>
</tr>
<tr>
<td>• Get others to leave the area, if possible.</td>
<td>• If in an unaffected area, stay where you are.</td>
<td>• Silence phones and remain quiet. Don’t let your phone give you away.</td>
</tr>
<tr>
<td>• Prevent others from entering the area.</td>
<td>• When you are safe, call UTA PD at 817.272.3003 or 911 with information you have.</td>
<td>• HIDE and take cover to protect yourself.</td>
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<tr>
<td></td>
<td></td>
<td>• Be prepared to run or defend yourself.</td>
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#### DENY

If you can’t leave the area safely, DENY or slow entry to the intruder:

- Lock/barricade doors with heavy items.
- Turn off lights/projectors/equipment.
- Close blinds and block windows.
- Stay away from doors and windows.
- Silence phones and remain quiet. Don’t let your phone give you away.
- HIDE and take cover to protect yourself.
- Be prepared to run or defend yourself.

#### DEFEND

If you can’t AVOID or DENY entry to the intruder, DEFEND your location:

- As a last resort, FIGHT for your life.
- Use physical force and any weapons available - fire extinguishers, books, chairs, belts, umbrellas, pens/scissors, hot coffee/drinks, trash cans, etc.
- Use the element of surprise.
- Work together as a team. Develop a plan. Commit to your actions. Your life depends on it.
- Be aggressive, loud, and determined in your actions.

Follow ALL instructions.

For more information, go to: [police.uta.edu/activeshooter](http://police.uta.edu/activeshooter)

Emergency: 817.272.3003
Non-Emergency: 817.272.3381
police.uta.edu