Course information

Version 2024-08-18

1 Welcome

Dear students, welcome to the course *Introduction to Drone Technolgy* Fall semester 2024.

My name is Kjeld Jensen[1] and I will be your primary teacher. For those of you who don't know me, I am Associate Professor and Vice Head of the SDU Drone Center. My research focuses on system design, computers and software for drones and autonomous systems. My recent research span the areas of autonomous drones, integration of drones into the lower airspace, wireless communication and IoT.

I have had the pleasure of teaching IDT since the SDU drone center was established in 2015 and I really enjoy teaching this course. For many of you this will be the general introduction to drone technology on top of your robotics or similar bachelor degree. We will work our way through the technologies that are key to autonomous drones. During the first part of the course you will be challenged by the theoretical topics of which at least some may be very new to you. During the last part the theory and concepts will begin falling into place as the course become more practical oriented. Towards the end you will develop software and hardware for a fully autonomous drone.

You are welcome to contact me between classes. I suggest that you use itslearning messages or drop by my office at the ground floor in the MMMI2 building to see if I am there. Due to difficulties keeping up with my inbox, you may experience delays if you send me an email so please use itslearning messages.

2 Learning objectives

The below learning objectives are an excerpt from the course information for your convenience. Please always refer to the *Introduction to Drone Technology* Course description[2] as the authoritative source of information. Please take your time to read the full course description thoroughly and remember that this forms the basis of the examination at the end of the semester.

Knowledge

Having completed this course the successful student possesses knowledge on an introductory level about:

- Multirotor Unmanned Aerial System (UAS), Unmanned Aerial Vehicle (UAV), power system, flight controller, attitude sensing
- UAV positioning and navigation based on Global Navigation Satellite System (GNSS)
- UAS wireless communication systems
- UAS safety & risk assessment

[1] https://sdu.dk/staff/kjen

[2] https://odin.sdu.dk/sitecore/index.php?a=searchfagbesk&bbcourseid=T550063101-1-E23&lang=en

Skills

Having completed this course the successful student is able to:

- Apply robotics competencies to the design and development of UAS

Competences

Having completed this course the successful student is able to:

- Participate in finding technical applicable solutions to the design and development of UAS subsystems and payload modules
- Contribute to the development in research and industrial UAS projects

3 Teaching location

We will conduct the first part of the semester at SDU-TEK. Here we will usually start the module by reviewing exercises from last week, if relevant, and discuss theory for the new exercises. You may stay in the classroom working in teams on the exercises until the teaching time ends. The last 4 modules we will move to the UAS Denmark testcenter[3] at HCA Airport where we have facilities for flying drones both indoor and outdoor.

While studying the Drones and Autonomous Systems (DAS) specialization or following Introduction to Drone Technology (IDT) as an elective course, you are granted access to the Dronelab at TEK for group work. If your student card does not provide access to Dronelab, please email our coordinator Mathilde Møldrup mms@mmmi.sdu.dk notifying her that you are a DAS/IDT student without access to Dronelab.

4 Teaching time

Teaching is Friday before noon according to the course plan available under Teacher's Course Information. Due to transportation time and extra time needed for the laboratory work the schedule has been extended to the full day for the modules conducted at HCA Airport.

5 Work load

This is a 5 ECTS course which is equivalent to approximately 135 hours. We will spend 48 hours during 12 modules of each 4 lessons leaving you about 7 hours per module for working on assignments and self-study.

6 Teaching philosophy

I consider myself a facilitator of learning rather than a classroom leader. In short this means that I will seek to encourage and facilitate your learning to the best of my ability. At the same time I expect you to take the lead and the responsibility for your own learning. This influences the agenda for each module and especially the lab exercises.

[3] https://uasdenmark.dk

7 Student teams

To the extent possible the teams should consist of 3 students. I am fairly agnostic about team composition, so after the introduction in the first module you will be asked to form teams yourself. The teams should ideally be kept throughout the course, but changes that everyone can agree on, will be accepted.

8 Course level, literature and other prerequisites

The course is mandatory to students at the Master in Robotics specializing in DAS. This defines the course level, and it is assumed that you have a background comparable to a bachelor in robotics especially concerning programming, embedded systems and sensor technology. If your line of study is different you may thus find the course challenging in terms of the prerequisites.

There will be no text book for this course. Some materials and references will be provided along with the course notes for the modules.

To conduct the exercises you will need to bring your computer. The exercises have been tested to work on Ubuntu 22.04 (and likely 24.04) and some requires Ubuntu, so you should either have Ubuntu installed on your hard drive or be able to run Ubuntu from a USB flash drive, or in VirtualBox or VMware.

9 Programming

The main programming language is Python. If you have little experience in programming, this will be a challenging course and you will need to set aside extra time for improving your skills.

One of my objectives is that you at the end of this course will have a set of software libraries and examples which may prove useful to you in the future. Some of these will be provided by me and some will be developed by you as part of the exercises.

I therefore recommend that you take the time to write structured code and especially that you encapsulate functionality in Python Classes and document these to an acceptable level.

I also recommend that you put a copyright statement and add a suitable license text in your source files. In order for your fellow students and others to take full advantage of your code, I recommend that you publish it under the open source BSD 3-Clause license. You will find examples on how to do this by looking at the code shared with you at the modules.

10 Lab exercise reports

During the semester your team will submit 8 reports. This will be short in-depth reports of 3-4 pages focusing on your methods, your results and a discussion hereof. Writing lengthy reports takes extra time, focus instead on understanding the theory well and conducting the exercises, then write a short report of good quality and no more than 4 pages. At the beginning of the semester I will publish more detailed instructions on report format and submission.

Please notice that submission of reports in due time is a prerequisite of the exam and the reports are also part of your overall assessment at the exam.

There may be times during the semester where you for some reason are unable to participate in the laboratory work and report writing. To this end I will accept that your name is missing on maximum 2 of the reports submitted during the semester. If you fail to contribute to more than 2 reports, I will report to the study administration that you do not meet the examination conditions.

Please notice that failing to contribute to a report during the semester does not exclude you from being questioned in the related theory and laboratory exercises conducted at the exam.

11 Exam

In January you will have an oral exam. At the beginning of your exam you will get 4 minutes to present a subject of your own choice from within the curriculum. Following your presentation we will ask you questions about various elements from the curriculum (theory and exercises) for a duration of 11 minutes. After those questions we will spend about 5 minutes on grading. When we have decided a grade we will let you back in and provide you the grade.