



## From Space to Drones: a synergy for Earth Observation

# Lecturers

**Name:** Associate Professor Panagiotis Partsinevelos

**Name for daily/classes use:** Panagiotis

**Background:** PhD in Spatial Informatics Engineering

**Specialization:** Associate Professor in Space Informatics

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[https://www.mred.tuc.gr/fileadmin/users\\_data/mred/cv\\_DEP/partsinevelos\\_en.pdf](https://www.mred.tuc.gr/fileadmin/users_data/mred/cv_DEP/partsinevelos_en.pdf)

**Name:** Professor Apostolos Dollas

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**Background:** Ph.D. in Computer Science

**Specialization:** Computers Architecture, Rapid System Prototyping, Hardware & Application Specific High-Performance Digital Systems, Computer Aided Design

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**Name:** Professor Stelios Mertikas

**Name for daily/classes use:** Mertikas

**Background:** Ph.D. from the Department of Geodesy and Geomatics Engineering

**Specialization:** Satellite precise positioning, navigation, quality control and remote sensing

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**Name:** Professor Ioannis Nikolos

**Name for daily/classes use:** Nikolos

**Background:** Ph.D. Department of Mechanical Engineering

**Specialization:** Fluid Section

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**CV:** [https://www.pem.tuc.gr/fileadmin/users\\_data/dpem/personnel/professors/first/2010\\_nikolosCV\\_en.pdf](https://www.pem.tuc.gr/fileadmin/users_data/dpem/personnel/professors/first/2010_nikolosCV_en.pdf)

## Course Description

**Title:** From Space to Drones: A synergy for Earth Observation

**Fields of activity:** Lecture, Tutorial, Project Work, Field Work, Workshop, Examination, Other (Discussion)

**Examination type:** Written examination (20%), Presentation (20%), Term project (40%), Participation - Assignments (20%)

**Number of ECTS credits issued:** 0

**Learning Goals and Objective:** Space technology in terms of products and services increasingly supports everyday applications from user to Earth level. Accordingly, Unmanned Aerial Vehicle (UAV or systems UAS) community has recently shown considerable growth, gradually embracing a wide range of applications. In order to migrate to the next generation of UAVs we need to deliver on demand, on-board, collaborative or autonomous functions, towards an intelligent UAV network transforming UAVs into decision operational systems. Yet, UAVs cannot be exclusively examined without the consideration of satellite Earth Observation (EO). Remote sensing satellites and micro-satellites provide multispectral images in varying temporal and spatial scales. Consequently, it is imperative to study the capabilities of Space and UAV systems in order to establish a holistic Earth Observation ecosystem. Through this seminar the above mentioned synergies will be examined, while research specifics will be delivered in order to acquire a strong basis for understanding the future of Earth observation under an application perspective. Applications refer to earth sciences, environmental monitoring, biodiversity, natural disasters, energy, trade, health, agriculture, cultural heritage, social sciences.



## **From Space to Drones: a synergy for Earth Observation**

The main goal of this course is to introduce the basics of Space and UAV technologies for everyday applications, spanning from the Earth system to the individual citizen. Therefore, the basic objectives to be reached include:

- Introduce satellite systems including Remote Sensing, GNSS, altimetry, etc.
- Introduce Unmanned Aerial Systems from the design phase to implementation,
- Demonstrate UAS autonomy, navigation, on-board and real-time processing, swarm intelligence, path planning and main research areas,
- Present a series of applications including Location based services, mapping, monitoring, sensors, 3D reconstruction, in Search & Rescue, Environment, Archaeology, Urban planning, Trade, Engineering, Infrastructure, Natural disasters, Geomatics, etc,
- Educate the basics of Space technology, proposal writing and presenting,
- Train interns in basics of safety and piloting Drones,
- Present the business side of the Space sector and train interns towards entrepreneurship, business modeling, pitching, etc.
- Stimulate true innovation and educate the mentality of high level basic & horizontal research.

# Syllabus

For each academical activity from the schedule, please provide the info in the form of the following table:

Name of activity	Introduction. Space technology and Satellite Systems (Lecture)
Number of working hours	2 hours
Type of activity	Lecture
Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	Learning and operation objectives of the Seminar. Outline, term project and Academic activities. Introduction to space exploration, satellite systems, sectors, and organizations. Satellite components, missions and logistics of the European Space Agency. The Copernicus and Galileo missions.
Bibliography	<a href="http://www.esa.int">www.esa.int</a> , <a href="http://www.nasa.gov">www.nasa.gov</a> .
Expected effect	The students will understand the function of the Academic part of the Seminar. Second they will be introduced to the basics of Space technology, Satellite types and main missions.

Name of activity	Intro to Unmanned Aerial Systems
Number of working hours	2 hours
Type of activity	Lecture
Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	UAV classifications, main components, legislation, design. Processing in real time, on-board systems, embedded programming. Applications including 3D reconstruction through photogrammetric and image processing algorithms and mapping products.

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Bibliography	Marshall, Barnhart, Shappee, Most, Introduction to Unmanned Aircraft Systems, CRC Press (not required).
Expected effect	Introduce Unmanned Aerial Systems from the design phase to implementation. Demonstrate UAS autonomy, navigation, on-board and real-time processing, swarm intelligence.

Name of activity	Time in computational Systems & embedded Architecture
Number of working hours	2 hours
Type of activity	Lecture
Lecturer	Professor Apostolos Dollas
Short summary of content	How time is significant for systems design in satellites and aerial systems. Embedded computing and architecture.
Bibliography	N/A
Expected effect	Comprehend time constraints and embedded basics.

Name of activity	Path Planning in UAVs
Number of working hours	2 hours
Type of activity	Lecture
Lecturer	Professor Ioannis Nikolos
Short summary of content	Path planning for Unmanned Aerial Vehicle (UAV) navigation.
Bibliography	N/A
Expected effect	Introduction to navigation basics of UAVs and view research projects for path planning.

Name of activity	Earth Observation - Remote Sensing
Number of working hours	2 hour
Type of activity	Lecture

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Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	Satellite remote sensing for Earth Observation (EO). Satellites, missions, electromagnetic spectrum, image types, basic processing. European Copernicus program and satellite missions. Landsat, SPOT, Sentinel, very high resolution, multi-hyperspectral systems.
Bibliography	Lillesand Thomas, Ralph W. Kiefer and Jonathan Chipman (2015), "Remote Sensing and Image Interpretation", 7th edition, Wiley (not required)
Expected effect	Understand the basics of Earth Observation.

Name of activity	Global Navigation Satellite Systems
Number of working hours	2 hours
Type of activity	Lecture
Lecturer	Professor Stylianos Mertikas / A. Prof. P. Partsinevelos
Short summary of content	Basic principles of satellite positioning, Global Positioning Systems, missions, applications. GPS, GLONASS, Galileo, BeiDu systems.
Bibliography	N/A
Expected effect	Understand the basics of satellite navigation systems, how they started how they operate and what are their

Name of activity	Applications of EO, GNSS & UAVs
Number of working hours	2 hours
Type of activity	Lecture
Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	Present a series of applications including Location based services, mapping, monitoring, sensors, 3D reconstruction, in Search & Rescue, Environment, Archaeology, Urban planning,

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	Trade, Engineering, Infrastructure, Natural disasters, Geomatics, etc,
Bibliography	N/A
Expected effect	Students will know how UAVs, Space, GNSS and EO can benefit society through applications.

Name of activity	Forming Space ideas
Number of working hours	2 hours
Type of activity	Workshop
Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	Students will form groups of 3-5 and start creating an idea based on the topics covered in the Seminar in the sectors of Earth Observation, UAS, GNSS or their combination. The objective is to create ideas that will bring space to Earth by addressing real societal problems.
Bibliography	<a href="http://www.esnc.eu">www.esnc.eu</a>
Expected effect	Idea formation and elaborate on feasibility and outcomes.

Name of activity	Senselab Laboratory Tour
Number of working hours	2 hours
Type of activity	Tutorial
Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	Students will visit Senselab Research Group in the Technical University of Crete and will get hands on experience in various IT and UAV experiments and implementations including: Drone implementation, real time processing, Robotically operated vehicles and collaboration with drones, sandmap formations for EO visualization, three-dimensional mapping with drones, Virtual reality environments, sensors and lidar, obstacle avoidance.

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Bibliography	<a href="http://www.senselab.tuc.gr">www.senselab.tuc.gr</a>
Expected effect	Students will have a first person experience from a globally renowned research entity for various products and processes.

Name of activity	Space: Business side
Number of working hours	2 hours
Type of activity	WorkShop
Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	Introduce business and entrepreneurship sides of Space and UAS sectors while student groups will prepare the Business Model Canvas of their idea. Business model, how to create revenue, marketing strategy, competition, obstacles and opportunities.
Bibliography	N/A
Expected effect	Students will be able to formulate the business segment of their idea.

Name of activity	Pilot training of UAVs
Number of working hours	2 hours
Type of activity	Field Work
Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	Introduce safety measures of UAV piloting, calibration procedure, real time processing, flight demonstration. All students will have a hands on experience of piloting a small scale UAV.
Bibliography	N/A
Expected effect	Learn the basics of preparation, safety measures and handling basic multi-copter UAVs.



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Name of activity	Term project writing & pitching
Number of working hours	2 hours
Type of activity	Project Work
Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	Project proposal writing, how to present – pitch an idea. Students in groups will write down their short proposal (term project) and design their presentation. At a later phase, groups could submit their proposals to European Satellite Navigation Competition – Greece Region in order to participate in the competition and be further evaluated by an expert's committee.
Bibliography	N/A
Expected effect	Students will learn the basics of project proposal writing, presenting pitching their idea.

Name of activity	Research Fundamentals
Number of working hours	2 hours
Type of activity	Other (Discussion)
Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	Science, research, basic vs applied research. Academic innovation, Academic ethics, study abroad experiences. Discussion on potential and personal endeavors. Discussion and input about the current seminar.
Bibliography	N/A
Expected effect	Students will learn to discern between research and simple applications in Academia and genuine innovation.

Name of activity	Exams - Presentations
Number of working hours	2 hours
Type of activity	Examination



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Lecturer	Associate Professor Panagiotis Partsinevelos
Short summary of content	Students will take a short exam in the form of multiple choice and 1-2 short descriptive questions. Then, the student groups will present their idea, receive questions from the audience and get evaluated.
Bibliography	N/A
Expected effect	Evaluation of students, public presentation.

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## Pre-materials

Here list all the materials that are relevant for the course. You can split them in section for online materials and books that people should find later.

### Links and Topics:

<b>Name</b>	<a href="http://geoinfo.amu.edu.pl/wpk/rst/rst/Front/tofc.html">http://geoinfo.amu.edu.pl/wpk/rst/rst/Front/tofc.html</a>
<b>Topic/field</b>	Basics and applications of Remote Sensing

<b>Name</b>	<a href="https://www.youtube.com/user/ESA">https://www.youtube.com/user/ESA</a>
<b>Topic/field</b>	ESA related videos

<b>Name</b>	<a href="http://www.mdpi.com/1424-8220/16/11/1844">http://www.mdpi.com/1424-8220/16/11/1844</a>
<b>Topic/field</b>	UAV publication for autonomous behavior

<b>Name</b>	<a href="http://www.mdpi.com/journal/remotesensing">http://www.mdpi.com/journal/remotesensing</a>
<b>Topic/field</b>	Open access publications on Remote Sensing