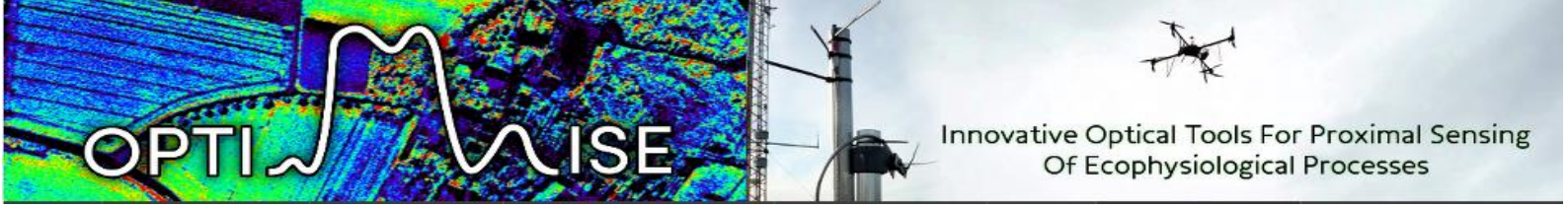

DRONELAB

UNIVERSITY OF EXETER

'SAFE OPERATIONS AND HEALTH AND SAFETY' in deployment of unpiloted aerial vehicles (UAVs) for environmental science

COST Action ES1309 'OPTIMISE' Training course

30 March – 6 April 2016

Training team: Dr Karen Anderson, Mr Leon Debell, Dr Enrico Tomelleri, Dr Andreas Burkart

Environment and Sustainability Institute DroneLab

University of Exeter, UK

COST is supported by the EU Framework Programme Horizon 2020

cost EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

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Course location

Environment and Sustainability Institute, Penryn Campus of the University of Exeter, Cornwall, TR10 9FE (search google maps for this post-code and you will find us.

How to arrive

Nearest train station: Penryn (Cornwall) is a 10 minute walk from the campus, or Truro (10 miles, and a £25 taxi ride)

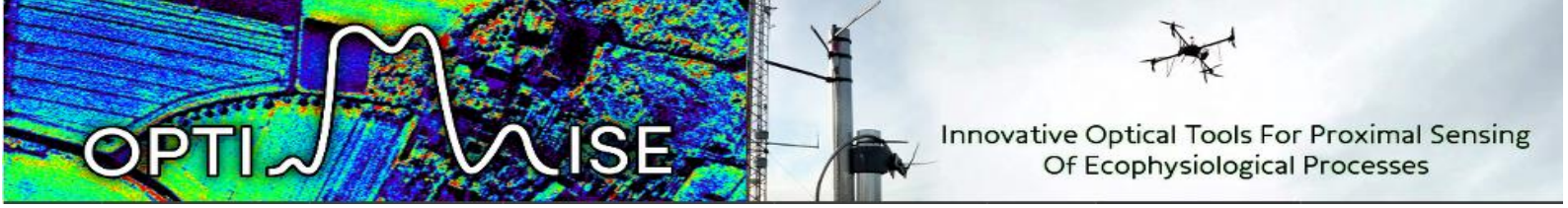
Nearest Airport: Newquay Cornwall Airport (45 minutes drive from campus, £45 in a taxi)

Bristol or Exeter airports are well served by trains to the South West of England and you should be able to reach campus in 4 hours from Bristol or 2.5 hours from Exeter by train.

London airports are 5 hours from Cornwall, and the most direct route from London is to travel by train from Paddington which is also connected to Heathrow by the Heathrow Express. Expect your journey to take at least 5 hours by train from London. There is also a sleeper service from London Paddington (on Great Western Railway) where you can book a sleeper berth and they will wake you up before arrival into Truro.

The campus is marked on the below map as a triangle. We are just outside of the beautiful maritime city of Falmouth and there will be time for delegates to do a bit of exploring here.

Delegates will be expected to find their own transportation to the course so as to ensure arrival before the commencement of training on 30th March.



Accommodation

Accommodation in the University's 'Glasney Parc' residences will be allocated to participants. Costs of this will be paid by the delegates on arrival and are not expected to exceed £35 per person per night. Lunches and refreshments will be provided by local organisers on most days but delegates will be responsible for funding their own dinner costs and breakfast (not included in the accommodation price but available on campus every day).

A minibus will be rented to provide local transportation to field sites.

Costs reimbursement

All the expenses related to the course participation (travel, accommodation, food) will need to be covered by your own.

After the training course, OPTIMISE trainees will receive a max. grant of €1200 to cover all expenses for attending the course. Any expenses above this amount will have to be at the expense of the trainees.

About the ESI

The University of Exeter's Environment and Sustainability Institute leads cutting-edge, interdisciplinary research into solutions to problems of environmental change; in so doing we are enhancing people's lives by improving their relationships with the environment.

Unlike many research institutes around the world, the ESI is not a virtual entity. Physically located on the University's Penryn Campus, near Falmouth, the research centre brings together state-of-the-art resources with leading academics and researchers in a brand new BREEAM Outstanding* rated building.

The ESI builds on the University's established research strengths. Alongside this we are working with businesses in Cornwall, the Isles of Scilly and beyond to translate research and expertise into innovative business practices, products and services.

The ESI has been enabled by a £30 million investment from the EU European Regional Development Fund (£22.9m) and the South West Regional Development Agency (£6.6m). The ESI is headed by inaugural Director and award-winning ecologist Professor Kevin J Gaston.

The ESI is home to Dr Karen Anderson's unique DroneLab – which is focused on delivering new data from proximal sensing to environmental science. The course will be based around experts from the DroneLab and with expertise from outside, including from the Royal Navy air squadron at Culdrose which operates a variety of complex aircraft including the drone-facilty 'ScanEagle'.

http://www.exeter.ac.uk/esi/

Course structure (TBC and subject to change)

This 7.5 day training school has the following learning outcomes:

- Learn about the major electronics components making up most lightweight drone systems and how to assemble and test them.
- Practice building and repairing a basic multirotor system, including how to perform aircraft initialisation testing, sensor fitting (including 3D printing) implementation of flight failsafes and pre-flight test procedures and calibrations.
- Develop flight skills in lightweight multirotor aircraft in both indoor and outdoor (operational) settings.
- Discover the range of sensors that can be included in drone-based remote sensing systems including optical, thermal, multispectral and hyperspectral and understand the types of scientific question that can be answered with data from these systems.
- Learn about key issues of spatial and radiometric data quality with the aforementioned systems, including calibration, validation and the need for particular supporting infrastructure and data on the ground.
- Discover how drone-based remote sensing data can be used in a variety of science areas and settings.
- Learn and practice how to plan for operational flying using open-source state-of-the-art software, plan your own flights and implement them in real settings.
- Learn about operational flight deployment and practice with spotters, pilots in command and mission control during real UAV flights.
- Learn from experts in drone and aircraft flight safety at the Royal Navy Culdrose centre about operational flight planning and safety.

Prior to the training school, all participants will be registered as members of the British model flying association so as to cover insurance for flying at field sites near to the University Campus. We will focus on training students with 3D Robotics airframes and the open source pixhawk control system. Simple airframes will be used to train students basic flight techniques in the field – for this purpose we will use multirotors outside and a combination of lightweight multirotor trainers and fixed wing aircraft inside. Uniquely, this course will teach small teams of students to build and then test their own UAVs, which is a key component of the process in safe flying. The following schedule details the course and dates along with the role of key trainers.

In summary, we will train through a process of ‘doing’ – participants will receive teaching and training in three ways:

1. Lectures and delivered material from expert trainers;

2. Hands on activities including building their own drone in a team and learning to fly it safely;

3. Hands on data processing using operational tools.

Programme of the course

Date, time	Location	Trainer	Content
29 March	UoE Penryn, Cornwall	n/a	Delegates arrive and check into accommodation. Dinner with training team at local restaurant.
Day 1: Defining concepts, key ideas and engineering design of UAVs			
30 March 1000	ESI, Penryn, Cornwall	Karen Anderson	Course welcome, structure, purpose
30 March 1100			Using UAVs for science: challenges, opportunities and new frontiers
30 March 1200			What is a UAV? Designs, operations and capabilities of different platforms
30 March 1245	Lunch		
30 March 1345	ESI, Penryn, Cornwall	Karen Anderson and Leon DeBell	Design, miniaturisation and integration of UAV components: remote sensing instruments, batteries GPS, DGPS and flight control.
30 March 1500		Leon DeBell	Introduction to the 'drone building' exercise, and kick off building in small teams.
30 March 1730	Conclusion		
30 March 1900	Dinner at a local restaurant		
Day 2: operations and safety, flight planning and basic control			
31 March 0930	ESI, Penryn, Cornwall	Karen Anderson	Aircraft control theory and flying safely with drones – rules and regulations for the UK
31 March 1000		Enrico Tomellieri	A European perspective on flight safety
31 March 1030		Leon DeBell and James Duffy	Operations manual and flight log – an introduction using a real example
31 March 1130		Karen Anderson and Enrico Tomellieri	Workshop – how to plan a UAV flight: responding to an operational brief, identifying risks and challenges *
31 March 1230	Working lunch		
31 March 1330	ESI, Penryn, Cornwall	Karen Anderson and Enrico Tomellieri	Groups deliver their flight risk strategies for the given scenarios. Debrief.
31 March 1400		DroneLab team	Flight skills (Hubsan) in research hall
31 March 1530		Leon DeBell and James Duffy	Dronebuild session 2
31 March 1730		Karen Anderson	Debrief and close
31 March 1900	Dinner at a local restaurant		

* In this session students will be given a survey brief and asked to produce a checklist of the necessary pre-flight checks that they would do before leaving base, from checking kit through to deployment and safe landing of the UAV. We will have a group discussion and de-brief after each group has presented their ideas about these different approaches and will compare against an 'ideal' pre-flight planning checklist. Battery management, site safety, GPS field markers and so on will be considered and discussed. Tools for assisting decision making will be demonstrated and discussed.

Day 3: sensors and data			
1 April 0930		Karen Anderson	Structure from motion – what is it, how can it be used, and how to optimise data quality?
1 April 1030		DroneLab team + Enrico Tomellieri + Andreas Burkart	Talks about research using drones in operational settings, from coasts, to the arctic to farms, to deserts, hyperspectral and structural data.
1 April 1230	Lunch		
1 April 1330	ESI, Penryn, Cornwall	Leon DeBell	Thermal sensing
1 April 1400		James Duffy	Kites as alternative platforms for proximal sensing
1 April 1430		Andreas Burkart	Flight skills (Hubsan) in research hall
1 April 1500		Leon DeBell and James Duffy	Dronebuild session 3
1 April 1630		All	Q&A
1 April 1900	Dinner at a local restaurant		
Day 4: Initial testing of dronebuild aircraft			
2 April 0930	ESI, Penryn, Cornwall	Leon DeBell	UAV battery charging and safe storage / transportation protocols
2 April 1000		Andreas Burkart + James Duffy	Fitting sensors – 3D printing and CAD
2 April 1030		Leon DeBell and James Duffy	Dronebuild session 4 – attaching payloads, testing protocols
2 April 1200		All	Perform initial tests of aircraft, complete basic pre-flight tests, charge batteries.
2 April 1300	Lunch		
2 April 1330	ESI, Penryn, Cornwall	Andreas Burkart	Flight skills (Hubsan) in research hall
2 April 1430		James Duffy	Using a DGPS – an example and practice.
2 April 1630		Leon DeBell and James Duffy	SfM in practice – a workshop with real data.
2 April 1900	Dinner at a local restaurant		
Day 5: Field flights, data processing and safety from Royal Navy perspective			
3 April 0900	Aerohub Newquay	All	Trip to Aerohub, Newquay to perform initial calibrations and test flights in a large hangar. Demonstrations of other drones in practice.
3 April 1200	ESI, Penryn, Cornwall	All	Battery charging, aircraft checking and maintenance, data download.
3 April 1300		All	Flight de-brief. Flight log completion, data download and processing.
3 April 1400	ESI, Penryn, Cornwall	Karen Anderson	Planning a real flight in Cornwall – operational insights and group task for day 6.
3 April 1500	Time off		
3 April 1900	Dinner at a local restaurant		

Day 6: Real operational flying, preparation, practice and processing			
4 April 0930	TBC	Commander Jason PHILLIPS OBE, RNAS Culdrose	Safety in drone flights from a military perspective.
4 April 1130	In the field	All	Undertaking data capture during a real flight with the built aircraft. In field checks, role playing, flight control scenario. Deployment and recovery.
4 April 1500	ESI	All	Flight de-brief. Flight log completion, data download and data processing commencement. Battery charging.
4 April 1900	Dinner at a local restaurant		
Day 7: Real operational flying, preparation, practice and processing			
5 April 1130	In the field	All	Undertaking data capture during a real flight with the built aircraft. In field checks, role playing, flight control scenario. Deployment and recovery.
5 April 1500	ESI	All	Flight de-brief. Flight log completion, data download and data processing commencement.
5 April 1900	Dinner at a local restaurant		
Day 8: Conclusion			
6 April 0930		All	Final presentations from the two groups – data collected, lessons learned and future directions.
6 April 1200	Course close		