EDU-UAV Photogrammetry Current Online Educational Landscape

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Abstract

UAV photogrammetry plays an essential role in applications such as disaster management, food security, and mapping due to its adaptability, scalability, and accuracy in data collection. Consequently, the increasing popularity of the UAV photogrammetry domain has led to a growing demand for comprehensive education accessible through academic institutions. Meanwhile, the flexibility and freedom associated with online education have sparked significant demand for online learning programs. Different users actively seek online courses and materials to delve into the intricacies of the field of UAV photogrammetry. However, the abundance of online resources in this area poses challenges in finding reliable ones.

To address this challenge, the ITC team from the UAV centre and EOS Department at the University of Twente investigated the current online education courses related to UAV Photogrammetry offered globally. They compiled an inventory of these courses, categorising them according to different educational levels- introductory, intermediate and advanced—to align with the needs of key photogrammetry user categories. The project also investigated the currently available UAV datasets and software packages that support both technical training and professional applications. Further details are available on the project **website**.

Keywords:

UAV Photogrammetry, Online Courses, Web Catalogue, UAV resources

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Table 1. Abbreviations

Abbreviations	Explanation
UAV	Unmanned Aerial Vehicle
SfM	Structure from Motion
DSM	Digital Surface Model
GIS	Geographic Information System
LiDAR	Light Detection and Ranging
ECTS	European Credit Transfer and Accumulation System
RGB	Red, Green, Blue (color channels)
ITC	Faculty of Geo-Information Science and Earth Observation, UT
UAV-L	UAV Landscape Survey
ODM	OpenDroneMap

1. INTRODUCTION

UAV photogrammetry is an important domain for many applications, UAV photogrammetry plays a significant role in many applications, such as environmental monitoring (Capolupo et al., 2015), disaster management (Kedys et al., 2024), (Giordan et al., 2018), food security (Muhammad Naveed et al., 2023), and utility management (Tilon et al., 2022).

The advantages of using the UAV platform lie in its flexibility, scalability, adaptability and reduced cost compared to traditional airborne or terrestrial instruments. UAVs have gained significant attention and foresee a promising future for expanding their applications and enhancing technological capabilities.

Many available UAV photogrammetry online courses and materials across different domains and levels of expertise enriched the learning landscape significantly. Online education can be categorized into different levels, such as continuing education, including professional development, and basic and advanced level courses.

However, this abundance of information and resources often adds many challenges when individuals and organizations are cross-referencing and searching for reliable and accountable sources.

As a result, there is a great need for an organized catalogue that can support searching for valuable, systematic information. Such an inventory is an accountable source, helping learners and educators filter the massive online resources efficiently and ease access to verified and trustworthy information. Besides, a catalogue could provide reliable information to acquire insights, asses the current status of the UAV photogrammetry online education, enhance the overall accessibility of online material, empowering learners and educators to make more informed choices.

2. OBJECTIVES AND WORK METHODOLOGY

This project, titled "EDU-UAV Photogrammetry Current Online Educational Landscape", funded by the ISPRS Capacity Building Initiative 2024, is carried out by the ITC faculty team at the UAV Center. The term "EDU-UAV" refers to the educational initiative focused on UAV (Unmanned Aerial Vehicle) photogrammetry, aiming to enhance the accessibility and quality of online education in this domain.

This project aims to create a comprehensive source that catalogues the available UAV online education courses classified at different levels and reflects the main photogrammetry user categories, such as academic and professional in the field of UAV photogrammetry offered by universities and institutions globally. Besides, to expand the project's scope, a comprehensive list of UAV photogrammetry software packages and UAV datasets suitable for educational and career development was also compiled.

The primary goal is to establish an openly accessible and interactive framework that serves as a guide, providing insights into the educational landscape of UAV photogrammetry. This resource will help both individuals and organizations gain a clear understanding of the online educational opportunities and activities available in the UAV photogrammetry community.

The data will be collected following systematic criteria and strategies addressing UAV photogrammetry online education courses at different levels. The gathered data will be categorized into efficient, easy retrieving information and user-friendly open-access website. The output will be a reliable source of information for the end users and scientists to use in their professional and academic lives. Besides, it will help understand the requirements, challenges and opportunities in this domain and identify the gaps, providing a foundation for informed decision-makers for effective future planning.
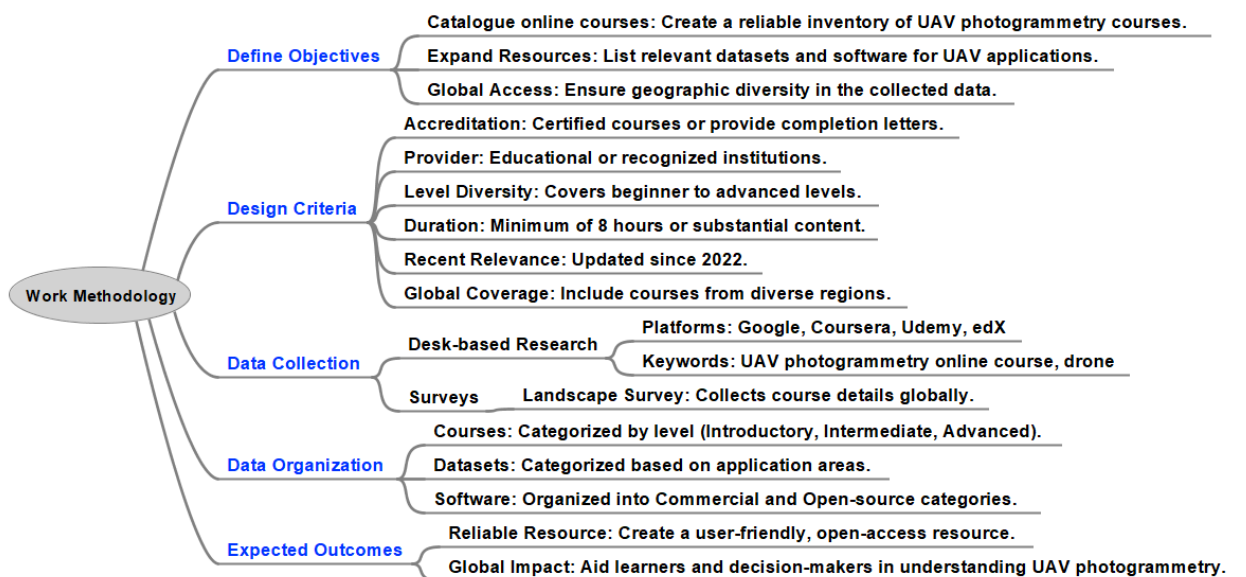
The work methodology is explained in Figure 1

Figure 1: Project work methodology

3. DESIGN CRITERIA

Given the substantial number of online courses available, it was essential to establish specific criteria to organize and collect UAV photogrammetry courses systematically. The design criteria were focused on ensuring that the resources gathered were relevant, up-to-date, comprehensive, and aligned with the project's goals. For UAV datasets and software packages, a more flexible approach was adopted to ensure the inclusion of resources that accommodate users with diverse interests, backgrounds, and needs.

Section 3.1 shows the specific criteria that were designed for the online courses. Section 3.2 explained the information to be collected for the courses, UAV data sets and the software packages.

3.1 Courses collection criteria

The following criteria have been used for course collection :

1. **Criteria 1: Course Accreditation**: The course is certified or provides a letter of completion, and it can be either credit-based or non-credit-based.
2. **Criteria 2: Provider Institution:** The course is offered by educational or non-educational institutions rather than an individual instructor. With this approach, we ensure the quality of the courses provided, as there are many online personal initiatives.
3. **Criteria 3: Educational Level diversity:** The collected courses will cover are categorized based on their educational level, including beginners, undergraduates, graduates, professionals
4. **Criteria 4: Course Duration:** The course or series of sessions has a minimum duration of 8 hours or covers a substantial portion of the photogrammetric pipeline.
5. **Criteria 5: Recent Relevance:** The course has been available or updated since 2022, ensuring that it reflects current developments and standards.
6. **Criterion 6 - Geographic coverage diversity**: the courses are collected globally to provide a general overview of the available courses worldwide.

3.2 Data to be collected

Related to the UAV online courses, the following information is aimed to be collected:

- Information related to the **Institution**, such as Institution Name and type of the Institution

- Information related to the **course details** such as Course Name, Course Description, course fees, and if it provided credits. Main Language or Languages, Delivery Method

- Information related to **the educational content of the course**, such as description, learning outcomes, knowledge areas or applications, knowledge prerequisites and the level of the course.

- Information related to the **target participants,** such as professionals or students.

Regarding UAV datasets, it was important to include descriptions and applications of each dataset to help users select the most appropriate resources that match their needs.

For UAV software packages, the focus was on selecting software packages dedicated mainly to processing UAV imagery for various applications. Besides, include both paid and free/open-source ones.

4. DATA COLLECTION

The ITC team employed various methods to gather information on available UAV photogrammetry online courses and identify gaps in UAV education. Additionally, we compiled a list of UAV software packages, both licensed and open-source, as well as UAV datasets that can be used for training and educational development.

A detailed explanation of the methods follows below.

4.1 Desk-based research

The desktop research for selecting relevant UAV courses involved three key steps. First, a Google search was conducted using keywords such as "UAV photogrammetry online course" and "UAV courses," but the results were limited. Second, the search was expanded to well-known academic platforms like Coursera, Udemy, and edX, using terms like "photogrammetry," "UAV," and "drone." Coursera yielded just one course that met the criteria, while Udemy provided several affordable options, though most were created by individual instructors and did not meet the desired standards. EdX offered a variety of courses and degrees from multiple universities, but only three relevant UAV courses were found. Finally, the search was extended to courses from top-ranked universities in Remote sensing according to the 2023 Global Ranking of Academic Subjects (Shanghai Ranking), but no relevant UAV application courses were identified due to language barrier or with most focusing on drone construction or navigation rather than photogrammetry.

For the documentation activity, we prepared an online form that consists of one sheet with the following fields and predefined categories:

Field	Description
Institution Name	The name of the Institution offering the course
Type of institutions	Educational Institutions, Research Institutions, Governmental Institutions, Profit/Private Institutions, and others.
Course Name	The name of the course
Course URL	The link to the website of the course
Duration and duration units	The duration of the course, including duration units such as hour, day, and month
Course fees	Including currency
Credits (ECTs)	The number of achieved ECTs (if any)
Main Language(s)	Main Language or Languages of the course
Delivery method	- Interactive: involves interaction time between the instructor and the participants, for example, via discussion boards or live-streaming lectures - Self-paced: no interaction between the participants and the instructors. Participants are independent and are provided with pre-recorded lectures and materials - For others, please specify
Course Description	The description of the course, including the description of the syllabus
Learning outcomes	The list of the learning outcomes of the course
Application fields	The main application field/s of the course such as agriculture, forestry, utilities, etc.
Knowledge Prerequisites	The prerequisite knowledge that is needed to enrol and excel in the course
	- Beginners: individuals with no prior knowledge or experience

Level of the target participants	- Undergraduate: individuals pursuing a bachelor's degree - Graduate: individuals pursuing a master's or doctoral degree - Professionals: individuals willing to enhance their knowledge and skills in a particular profession
The level of the course	- Introductory or foundational courses - Intermediate level including more depth and deeper understanding courses - Advanced or specialised courses
Remarks	Any additional information about the course

Table 1: . Online Course Information Collection Form.

The ITC team documents **13 courses**. Additional **1 courses** have been documented using EDU-UAV Photogrammetry Current Online Educational Landscape Survey as described in section 4.2.1. The complete list of the collected courses can be found in Appendix A.

The two lists of UAV software packages and UAV datasets were compiled through a desk-based approach. This process involved consulting various online specialized websites and relevant industry platforms. The team's collective expertise in UAV technology also played an important role in identifying and verifying key resources, ensuring the lists were both comprehensive and up-to-date.

For the UAV datasets, information was gathered, including the name of each dataset, a description of its contents, the specific applications it supports, and a direct link to access the dataset. This structured approach will help users easily identify the most suitable datasets for their particular training and educational development needs. In total, **13 datasets were listed**. The complete list of the UAV datasets can be found in Appendix B.

Similarly, the UAV software packages list was compiled with a focus on the name of each software, the company or organization behind its development, and the company's headquarters location. Additionally, information was collected on the primary industries the software serves, allowing users to understand better the context and potential use cases for each package. Both licensed software and free/open-source UAV software were included to offer a wider range of options to the end users. In total, **12 software packages** were collected. The complete list of the software packages can be found in Appendix C.

4.2 Survey

The online survey was also designed to collect information about the UAV photogrammetry online courses globally. The survey was conducted and later distributed on the EUSurvey. The EUSurvey is a web application created and managed by the Directorate General for Informatics of the European Commission, herewith known as "DIGIT" (https://ec.europa.eu/eusurvey/home/tos).

4.2.1 EDU-UAV Photogrammetry Current Online Educational Landscape Survey

The online survey has been prepared to expand the geographic coverage and diversity of the collected information. Moreover, it captured insights into the transversal skills acquired through the identified DPs. The survey questions included close, multiple choice and short answers questions. They were designed to be clear (showing examples for some) and direct, with a predefined list of answers (when possible) to receive more concrete/concise answers. The participants could also upload files or specify additional relevant websites. Only 2 questions were mandatory, including the name and the course website. The survey was designed to maintain the anonymity of participants, ensuring that no personal data was collected.
The online survey is divided into four main sections:
- Section 1: Information about the course consisting of 11 questions.
- Section 2: Details of the respondent and Institution consisting of 3 questions.
- Section 3: Additional information and submission consisting of 2 questions.

Appendix D shows the complete survey with all sets of questions. The survey was shared on the ITC team's LinkedIn profiles and distributed to the ITC UAV centre email list (259 email addresses). Despite our efforts, only two responses were collected and documented, and only one matched our criteria to be added to the website.

5 EXPECTED OUTCOMES

This section examines the current landscape of UAV education, including course providers, applications, and delivery methods. It also explores available datasets and software tools for UAV photogrammetry, highlighting their diverse applications across various industries.

5.1 Analysis of the courses

The courses listed include several UAV-oriented courses being offered by universities and private entities specifically designed on organized areas ranging from photogrammetry to environmental sciences and precision agriculture. In the following, we introduce a brief analysis regarding key properties and key findings:

1. Course Providers
    - Universities: Educating institutions such as Wageningen University, University of Alaska Fairbanks, Duke University, and the University of Twente typically offer programmes with very academic orientation: these often stress scientific principles, real-world applications, and integration of UAVs into agricultural geospatial sciences and environmental monitoring.
    - Private Institutes: Some companies, such as Dart Drones, Drone Valk, and Pix4D offer a more practical education, trying to match the needs of professionals in the industry sector.

2. Course Applications
    - Geospatial Science: Some courses related to UAV studies are offered within the University of Twente, which involve UAV-based photogrammetry, mapping, and geospatial applications.
    - Environmental Science and Monitoring: UAV applications for monitoring and data collection within different kinds of ecosystems are effectively addressed by "Drones for Environmental Science" at Duke University and another advanced sensing course from Wageningen University.
    - Agriculture: The domain of precision agriculture that works with UAVs concerning UAV sensing, hyperspectral imaging, and crop management is illustrated by Wageningen University, DroneValk, and the University of Twente.
    - Introductory UAV courses: Introductory courses such as "AlaskaX: UAS Fundamentals" introduce the UAV platform, the sensors, safety in flight, and basic applications.

3. Course Features
    In general, the courses have the Learning Outcomes of understanding some important UAV applications (mapping, sensing, and visualization), integrating sensors with UAV platforms for specific applications, and gaining practical skills in agriculture and urban planning.
    Apart from this, these courses quite generally focus on skill building.

    - Technical: Data acquisition, sequencing of flights, and operating UAVs.
    - Analytical: Data analysis, GIS, and photogrammetry.
    - Professional: Project design and UAV mission analysis.

4. Course Audience and Prerequisite of the Course
    - Beginner: Depending on the course, the basics of the drone would vary as the courses "Drones for Environmental Science" or "UAVs in Precision Agriculture". However, this kind, of course, is for beginners or freshly graduated students who studied extensive basics of drones during the course.
    - Intermediate and Advanced: An advanced course from the University of Twente that would only help if a person had a former understanding regarding work in geospatial sciences or agriculture.

5. Delivery
    - The time duration of the course would vary from a few hours to a few weeks as some courses are hardly 6 weeks (about 1 and a half months) from Wageningen University, and some follow self-paced learning type.
    - Self-paced Learning: Coursera's, edX's, and Udemy's platforms provide flexibility for participants to finish the course at their own pace.

- interactive Learning: Some university courses blend online content with face-to-face training sessions

6. Certification

Completion certificates are awarded at the end of the course by the course providers, which can be important for job validation and professional development.

7. Cost

Some are offered freely; others are reasonably priced; however, those that are delivered by university faculties can be somewhat costly.

5.2 Analysis of the datasets and software packages

Different UAV datasets serve applications such as urban planning, agriculture, object detection, and disaster management. Each dataset offers good insights for specific areas of research and operational use. Researchers are responsible for selecting datasets appropriate to their project-related objectives, making sure the consideration of data type, resolution, and annotations is perfectly suitable.

The list of UAV photogrammetry software packages highlights a range of tools with diverse applications across various industries, including surveying and mapping, construction, agriculture, mining, and public safety. These software solutions from companies around the world, cater to sectors ranging from large-scale industrial use to more flexible, smaller-scale operations.

Most of these software tools are paid licenses with varying pricing values, although many offer trial versions or educational versions for users. The last two options, **OpenDroneMap** and **OpenSfM**, are open-source and free, making them accessible to a broader range of users, including researchers and those working with limited budgets.

6 DISSEMINATION OF THE RESULTS

The outcomes from the project will be delivered through a range of platforms and communication channels to maximize reach and accessibility to the target audience. The dissemination strategy of our project aims to engage stakeholders across the academia-industry and professional communities interested in UAV photogrammetry and geoscience applications.

6.1 Online Publication

A compiled inventory of UAV photogrammetry online courses, datasets, and software packages is published on the ITC UAV centre as an open-access **website**, as shown in Figure 6. This will allow easy navigation by the user to search courses based on their levels, detailed descriptions and categorization of datasets and software. To ensure continuous improvement, a feedback mechanism will be implemented on the open-access platform, allowing users to suggest additional courses, datasets, or software and share their experiences using the platform, or can directly fill in the form here.

This way, the resource will remain relevant and evolve with the needs of the community. By continuously updating the platform based on user feedback, it will remain a dynamic and valuable tool for those interested in UAV photogrammetry.
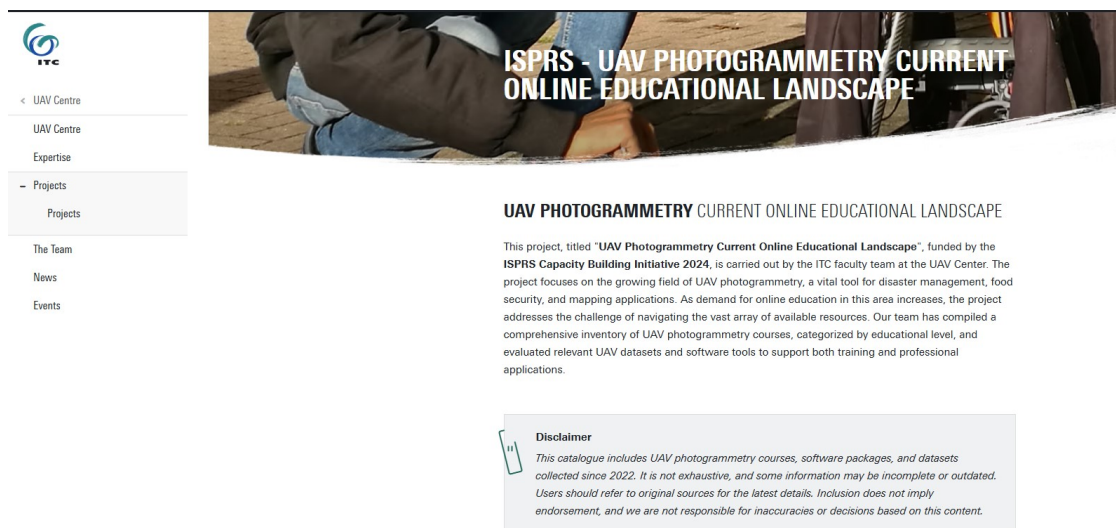

Figure 2: Screenshot (1) of the project website showcasing the main interface and key features
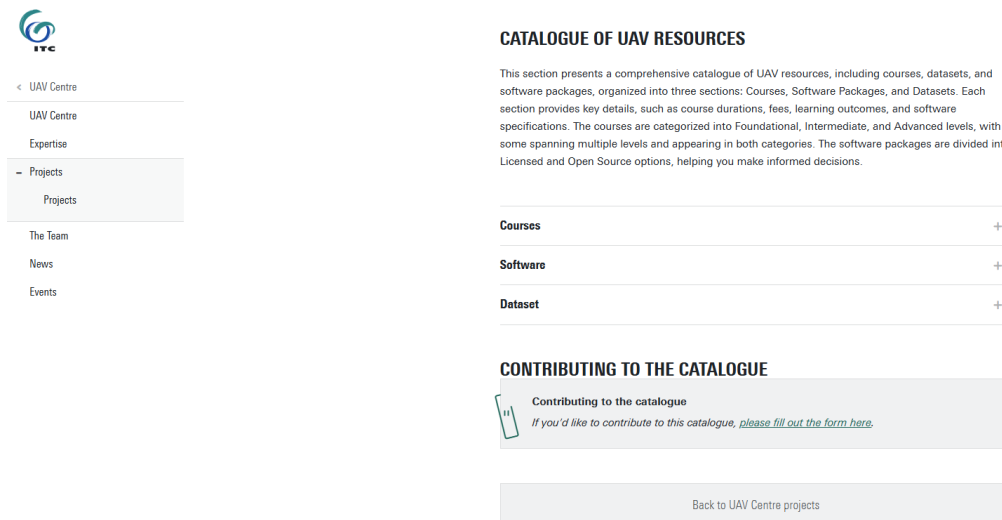
Figure 3: Screenshot (2) of the project website showcasing the main interface and key features

6.2 Conferences and Social Media

Project results is disseminated to the major global stakeholders at the ISPRS Geospatial Week 2025 Dubai, i.e. based on geospatial and mapping professionals and researchers attending the conference. By doing this, results will be communicated directly to universities and training centers to help them improve their curricula and fill the established knowledge gaps.

Besides, The ITC UAV center will use social media like LinkedIn, Twitter, and Facebook to provide updates, showcase project outputs, and encourage contributions or feedback from stakeholders.

7. CONCLUSIONS AND DISCUSSIONS

The project investigated the global landscape of UAV photogrammetry online courses and was extended to include free UAV datasets and UAV software packages. While a wide variety of software packages and data sets are broadly accessible, the availability of online courses is quite limited, practically those developed by institutions offering certificates upon completion. However, individual initiatives are extensively available, but their quality can be difficult to assess. On the other hand, many available courses focus on practical training and UAV design and assembling.

UAV Courses span a broad spectrum from the fundamental principles of UAV to specialized application areas, including agriculture, environmental monitoring, and geospatial sciences. The courses offer diverse learning needs for everyone from the beginner level to the experienced professional, and they can be free or inexpensive, while those providing certifications and university-run courses tend to be high-priced. Besides, Courses offered are mostly integrated with real-world examples and case studies, which is very useful for professional participants.

Furthermore, online UAV courses are limited and variable in terms of their objectives, prior knowledge, and professional orientation. For example, beginners should easily start their careers with courses such as "Drones for Environmental Science" and "UAS Fundamentals" while advanced university courses offered by Wageningen University or the University of Twente would be a strong direction for those in the agriculture and geospatial sciences.

Additionally, there are number of online UAV datasets and software packages, UAV datasets and photogrammetry software support diverse applications across research and industry. Selecting the right combination depends on project goals, data needs, and available resources.

8. ACKNOWLEDGEMENTS

9. REFERENCES

Capolupo, A., Pindozzi, S., Okello, C., Fiorentino, N., Boccia, L., 2015. Photogrammetry for environmental monitoring: The use of drones and hydrological models for detection of soil
contaminated by copper. Science of The Total Environment 514, 298-306.

Giordan, D., Hayakawa, Y., Nex, F., Remondino, F., Tarolli, P., 2018. Review article: the use of remotely piloted aircraft systems (RPASs) for natural hazards monitoring and management. Nat. Hazards Earth Syst. Sci. 18, 1079-1096.

Kedys, J., Tchappi, I., Najjar, A., 2024. UAVs for Disaster Management - An Exploratory Review.
Procedia Computer Science 231, 129-136.

Muhammad Naveed, T., Yubin, L., Yali, Z., Huang, W., Yingkuan, W., Syed Muhammad Zaigham Abbas, N., 2023. Chapter 4 - Application of unmanned aerial vehicles in precision agriculture, in: Zaman, Q. (Ed.), Precision Agriculture. Academic Press, pp. 55-70.

Tilon, S., Nex, F., Vosselman, G., Sevilla de la Llave, I., Kerle, N., 2022. Towards Improved Unmanned Aerial Vehicle Edge Intelligence: A Road Infrastructure Monitoring Case Study. Remote Sensing 14, 4008.

APPENDIX A – UAV COURSES

No.	Institution Name	Course Name	Course URL	Level of the target participants (Beginners, Students,	Level of the course (Introductory or foundational
1	DartDrones	Aerial Mapping and Modeling with DroneDeploy Workshop	Virtual Mapping and Modeling Workshop - DARTdrones	professionals	Introductory or foundational courses
2	Pix4d	Pix4D Essentials certifications	https://training.pix4d.com/pages/online-courses	Beginners, Students, Professionals	Introductory or foundational courses, Intermediate, Advanced or
3	The Pennsylvania State University	Unmanned Aerial Systems	https://geospatial.psu.edu/geog892	Students	Intermediate
4	Wageningen University & Research	Drones for Agriculture: Prepare and Design Your Drone (UAV) Mission	https://www.mooc-list.com/course/drones-agriculture-prepare-and-design-your-drone-uav-mission-edx	professionals	Intermediate
5	University of Alaska Fairbanks	AlaskaX: Unmanned Aerial Systems (UAS): Fundamentals	https://www.edx.org/learn/science/university-of-alaska-fairbanks-unmanned-aerial-systems-uas-fundamentals?index=product&objectID=course-358335f2-b350-41ad-bb95-	students and professionals	Introductory or foundational courses
6	Duke University	Drones for Environmental Science	https://www.coursera.org/learn/drones-for-environmental-science	Beginners, students and professionals	Introductory or foundational courses
7	Drone Valk	DRONE - IMAGE SURVEYING AND PROCESSING	https://www.udemy.com/course/drone-legislacao-levantamento-e-processamento-de-imagens/?couponCode=ST10MT8624#instructor-1	Beginners, students and professionals	Introductory or foundational courses, Intermediate, and Advanced
8	Drone Valk	GIS with ArcGIS - Basic to Advanced	https://www.udemy.com/course/sig-com-arcgis-basico-ao-avancado/?couponCode=ST10MT8624	Professionals	Introductory or foundational courses, Intermediate, and Advanced
9	Wageningen University & Research	Drones for Agriculture: Prepare and Design Your Drone (UAV) Mission	https://www.edx.org/learn/drones/wageningen-university-research-drones-for-agriculture-prepare-and-design-your-drone-uav-mission?index=product&queryID=e659cd	Professionals	Intermediate
10	Wageningen University & Research	Drones for Agriculture: Advanced Sensing and Analysis	https://www.edx.org/learn/drones/wageningen-university-research-drones-for-agriculture-advanced-sensing-and-analysis?index=product&queryID=37dd28297ab75ba43ad5003b1da37b1c&positi	Students, Professionals	Intermediate

11	University of Alaska Fairbanks	Unmanned Aerial Systems (UAS): Fundamentals	https://www.edx.org/learn/science/university-of-alaska-fairbanks-unmanned-aerial-systems-uas-fundamentals?index=product&queryID=ac4dfed3587a6c62dfb0efd73d009ff7&pos	Beginners, students and professionals	Introductory or foundational courses
12	University of Twente/ ITC Faculty	Earth Observation with Unmanned Aerial Vehicles	https://www.itc.nl/education/study-finder/earth-observation-with-unmanned-aerial-vehicles/	Students	Advanced or specialized courses
13	University of Twente/ ITC Faculty	UAVs in Precision Agriculture	https://www.geoversity.io/courses/uavs-in-precision-agriculture/	Students, Professionals	Introductory or foundational courses
14	Duke University	UAS Applications and Operations in Environmental Science courses series	https://marineuas.net/new/education/	Students, Professionals	Intermediate and Advanced or specialized courses

APPENDIX B- UAV DATASETS

1. Pix4D Dataset
- URL: https://support.pix4d.com/hc/en-us/articles/360000235126
- Description: This dataset provides example projects processed using Pix4D software. It includes datasets for 3D mapping, orthophoto generation, and digital surface model (DSM) production, suitable for applications like construction, agriculture, and site monitoring.
- Application: Photogrammetry, 3D modelling, and precision mapping.

2. AgEagle (SenseFly Resources)
- URL: https://www.sensefly.com/resources/?filter_by=data-set
- Description: Contains sample datasets for agricultural mapping, environmental monitoring, and land use studies. It features high-resolution UAV imagery captured using SenseFly drones.
- Application: Precision agriculture and environmental monitoring.

3. Mid-Air Dataset
- URL: https://midair.ulg.ac.be/
- Description: A synthetic dataset designed for drone navigation and perception tasks. It provides simulated aerial data for training autonomous navigation algorithms.
- Application: UAV navigation, reinforcement learning, and computer vision.

4. VisDrone Dataset
- URL: https://github.com/VisDrone/VisDrone-Dataset
- Description: A large-scale dataset for object detection, tracking, and counting in drone-captured videos. It includes annotations for traffic scenes, pedestrian detection, and environmental surveillance.
- Application: Object detection, tracking, and urban monitoring.

5. UAV Sample Dataset
- URL: https://www.iitr.ac.in/uasg2023/sdata.html
- Description: Provides sample UAV datasets for photogrammetry and mapping applications. It contains Orthomosaic and DSM data useful for geospatial research.
- Application: Academic research and photogrammetry studies.

6. ASL Dataset
- URL: https://projects.asl.ethz.ch/datasets/doku.php?id=weedmap:remotesensing2018weedmap
- Description: Focused on remote sensing and vegetation monitoring, this dataset includes imagery for detecting and classifying weeds in agricultural fields.
- Application: Precision agriculture and vegetation classification.

7. Stanford Drone Dataset
- URL: https://cvgl.stanford.edu/projects/uav_data/

- Description: Captures real-world pedestrian and vehicle movement in outdoor environments, annotated for tracking and behaviour analysis.
- Application: Traffic monitoring, pedestrian behaviour analysis, and urban planning.

8. Okutama-Action Dataset
- URL: http://okutama-action.org/
- Description: High-resolution videos of dynamic scenes annotated for human action recognition and detection in aerial views.
- Application: Action recognition and behavioural studies using UAV data.

9. Zurich Urban Micro Aerial Vehicle Dataset
- URL: https://rpg.ifi.uzh.ch/zurichmavdataset.html
- Description: Provides urban aerial imagery and video data, including trajectory information for micro aerial vehicle (MAV) applications.
- Application: Urban planning, trajectory analysis, and aerial mapping.

10. Open Cities AI Challenge Dataset
- URL: https://www.drivendata.org/competitions/60/building-segmentation-disaster-resilience/page/151/
- Description: A dataset focused on building segmentation for disaster resilience. Includes pre- and post-disaster UAV imagery.
- Application: Disaster management and building footprint analysis.

11. IEEE Datasets
- Active Object Detection: https://ieee-dataport.org/documents/active-object-detection-uav-remote-sensing-behavior-cloning-and-shallow-feature-enhanced-q
- Peach Tree Disease Detection: https://ieee-dataport.org/documents/peach-tree-disease-detection-dataset
  - Description: Offers datasets for active object detection and agricultural disease monitoring, emphasizing UAV applications.
  - Application: Object detection and precision agriculture.

12. ODMData
- URL: https://www.opendronemap.org/odm/datasets/
- Description: Contains open datasets for UAV mapping and analysis using OpenDroneMap.
- Application: Open-source UAV mapping and community-driven research.

13. UseGeo Dataset
- URL: https://www.sciencedirect.com/science/article/pii/S2667393224000140
- Description: A multi-sensor UAV dataset designed for geospatial research, including high-resolution imagery and sensor data.
- Application: Geospatial studies, multi-sensor data fusion.

APPENDIX C – UAV SOFTWARE PACKAGES

Commercial (Paid License)	
DJI Terra	
	Company: N/A
	Headquarters China
	Website: DJI Terra
	Industries: some examples: Surveying &Mapping, Power Industry, Public Safety, Oil &Gas, Agriculture
Pix4Dmapper	
	Company: Pix4D S.A.
	Headquarters Switzerland
	Website: Pix4Dmapper
	Industries: Surveying &Mapping, Architecture, Engineering, Construction (AEC), Precision Agriculture, Energy, Utilities and Infrastructure, Forensics & Public Safety
Agisoft Metashape	
	Company: Agisoft LLC
	Headquarters: Russia
	Website: Agisoft Metashape
	Industries: NA
DroneDeploy	
	Company: DroneDeploy, Inc.
	Headquarters United States
	Website: Drone Deploy
	Industries: Construction, Oil & Gas, Renewable Energy, Agriculture, Mining & Quarries, Utilities, Roofing, Property Management
Propeller	
	Company: Propeller Aero Pty Ltd
	Headquarters: Australia
	Website: Propeller Aero
	Industries: Constructions, Aggregates + Mining, Waste management, Survey+Engineering
Mapware	
	Company: Mapware
	Headquarters United States
	Website: Mapware
	Industries: Oil & Gas ,utilities, construction, Telecom, Property Management, Agriculture, Public Safety, Defense
DroneMaps by Skycatch	
	Company: Skycatch, Inc.
	Headquarters United States
	Website: DroneMaps

	Industries: NA
3D survey	
	Company: 3D survey
	Headquarters Slovenia
	Website: 3D survey
	Industries: Construction, Land surveying, Surface Mining
Pixpro	
	Company Name: Pixpro UAB
	Headquarters: Lithuania
	Website: Pixpro
	industries: inspection and measurement, accident documentation, mining maintenance, slope monitoring and landslide prevention, waste management
PhotoModeler	
	Company: PhotoModeler Technologies
	Headquarters: Canada
	Website: https://www.photomodeler.com/products/
	Industries: Fabrication and Manufacturing, Marine Fabrication, Public Safety and Forensics, Engineering, Architecture, and Surveying, 2D Template Pattern Digitizing, Mining and Geology, Science, Academics, Research, and Education, Film and Animation
3DF ZEPHYR	
	Company: 3DFLOW
	Headquarters: Italy
	Website: https://www.3dflow.net/3df-zephyr-photogrammetry-software/
	Industries: Forensics, Surveying, Archaeology, Architecture, Marine modeling, cultural heritage, Virtual and Augmented Reality, geology, Precision Agriculture, Photogrammetry & BIM
Open Source software packages	
OpenDroneMap (ODM)	
	Company: Community-driven project
	Headquarters: NA
	Website: OpenDroneMap
	Industries: NA
OpenSfM	
	Company: NA
	Headquarters: NA
	Website: SFMTool
	Industries: NA

APPENDIX D – UAV ONLINE LANDSCAPE SURVEY

EDU-UAV Photogrammetry Current Online Educational Landscape Survey

Fields marked with * are mandatory.

Introduction

As part of the **ISPRS Capacity Building Initiative 2024**, the University of Twente, Faculty of Geo-Information Science and Earth Observation, **ITC Team at the UAV center** aim to collect information about **UAV Photogrammetry online courses** offered by universities and institutions **globally** to subsequently create a comprehensive source that **catalogues the available online education courses** classified at different levels and make it available **via an open access website** to different categories of end users.

Kind instructions for completing the survey:
- Questions marked with a red asterisk **(*)** are mandatory.
- The time required to complete this survey is around **6 minutes.**
- You have **unlimited number of contributions** to this survey. ● You can save your contribution **as a draft** and continue later.

We would really appreciate it if you could complete the following survey at your earliest convenience.

Please do not hesitate to contact (mailto:y.y.q.alasmar@utwente.nl) us if you have any questions.

Thank you in advance for your contribution.

Disclaimer!

The survey is designed to maintain the anonymity of participants. All the data provided will be handled confidentially, and the information will be published in an aggregated form that does not trace to individual entries. The analysis does not include any personal data, but in case you choose to share your personal information, it will be processed solely for purposes related to the project and in compliance with the General Data Protection Regulation (GDPR).

Do you consent to us storing and processing your information as clarified above?

☑ I accept your Terms
By accepting our terms, you give us consent to store and process your information as clarified above.

Section 1: UAV Photogrammetry Online Course

*Q1.1 Please write down the Name of the UAV online course (e.g. Introduction to UAV Photogrammetry)

```
```

*Q1.2 Please provide us with the link to the online course website.

```
```

Q1.3 Please select the course level according to the complexity of the content covered.

○ Introductory or foundational courses

○ Intermediate level including more depth and deeper understanding courses

○ Advanced or specialized courses

Q1.4 Please select the level of the target audience of the course:

○ **Beginners:** individuals with no prior knowledge or experience

○ **Undergraduate:** individuals pursuing a bachelor's degree

○ **Graduate:** individuals pursuing a master's or doctoral degree.

○ **Professionals:** individuals willing to enhance their knowledge and skills in a particular profession.

For others, please specify
```
```

Q1.5 Please select the online delivery method of the course:

○ **Interactive** involves interaction time between the instructor and the participants, for example, via discussion boards or live-streaming lectures.

○ **Self-paced:** no interaction between the participants and the instructors. Participants are independent and are provided with pre-recording lectures and materials.

For others, please specify

[   ]

Q1.6 Please select the options that apply to your course (more than one option can be selected):

- ☐ The course is a summer school
- ☐ The participant will be assessed and receive a certificate by the end of the course
- ☐ The course has tuition fees
- ☐ The course is free of charge
- ☐ The course offers ECTS *(European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load)*
- ☐ The course will run again for the next 2 years
- ☐ The course offers practical exercise
- ☐ The course offers entrepreneurship skills

Q1.7 Please select the application field/s of the course *(Please select the most relevant ones, maximum 2):*
- ☐ Forestry and natural resource management.
- ☐ Sustainability including climate change.
- ☐ Disaster management
- ☐ Marine and water management
- ☐ Agriculture and precision farming
- ☐ Surveying and topographic Mapping
- ☐ Archaeology and Cultural Heritage
- ☐ Infrastructure and Urban Planning
- ☐ Automation, robotics, Artificial intelligence
- ☐ 3D modelling and visualization (including gaming

For others, please specify

[   ]

Q1.8 Please indicate the duration of the course, including the unit (e.g. 3 weeks or 10 working days).

[   ]

Q.1.9 Please indicate the Language or Languages of the course.

[   ]

Q1.10 Please provide the descriptions, including the course learning outcomes. *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

[   ]

Please upload your file here

Q1.11 Please provide the prerequisites required for enrolment in the course, if any.

[   ]

Section 2: Your details and your Institute

Q2.1 Please indicate the institute name that your are responding on behalf of.

[   ]

Q2.2 Please specify the type for the institute: ◯
Educational Institution

◯   Research Institution

◯   Governmental Institution ◯
Profit/ Private Institution

For others, please specify

[   ]

Q2.3 Please specify your job title/ role in the institute.

[   ]

Section 3: Additional Information and Submission

Q3.1 If you have any additional information/comments regarding the course or the survey, please add them here.

[   ]

Please add another course:

o   Yes, I want to add another course

o   No, I want to submit the survey

Contact
Contact Form (/eusurvey/runner/contactform/7bf5730c-1b63-c39b-1c7c-06663e63e7d0)