Micro-module C: Remote Sensing

Module C will introduce the main sources of remote sensing data, data characteristics and application scenarios in the field of urban research. In this module the steps to obtain a model of the urban commons through UAV scanning and ground scanning will be presented. In addition, this module will introduce the acquisition methods, processing methods and applications of optical satellite remote sensing data in research.

This module mainly includes two micro-modules, which are respectively the method of constructing research model by using data obtained from 3D scanning of UAV and the method of using optical remote sensing data obtained from remote sensing satellite.

1. Introduction

1.1 Data Sources

Remote sensing is the use of detectors to acquire data in a non-contact, long-range manner. The sources of its data are diverse, with satellites, fixed-wing aircraft and UAV all being common data platforms. The earliest remote sensing dates back to 1858 with photographs taken over Paris via hot air balloons, systems of aerial photography were used to mature between the First World War and the Cold War, and satellite technology in the second half of the twentieth century led to the development of earth observation on a global scale, and its detection of the earth's surface, oceans, atmosphere and other planets. In terms of data acquisition, remote sensing can be divided into passive, meaning that the detector itself does not emit electromagnetic waves to the target, but detects natural electromagnetic waves reflected by the target, such as optical remote sensing, and active, meaning that the detector generates electromagnetic waves to the target and receives the echoes of those waves, such as Light Detection and Ranging (LiDAR) point clouds and radar.

1.2 Data characteristics and application

Optical remote sensing images can provide the spectral reflection characteristics of objects in overhead view, so they can be applied to land use change monitoring, disaster monitoring (e.g. mountain fires, mudslides), vegetation phenology change, urban heat island, etc. Point cloud data presents spatial and radiometric information of objects in 3D, which is advantageous in autonomous vehicles, aboveground biomass calculation, building morphology parameterization, etc.

In recent years remote sensing has also been increasingly used as a new tool for studying urban problems and it has the following advantages.

Remote sensing data has a low cost of acquisition. Unlike other geographic data, which is dependent on government openness, low resolution remote sensing data is mostly free and open, while high resolution remote sensing data can also be purchased from the appropriate company.

Remote sensing data is usually available on a long and consistent basis. For example, the Landsat programme, run by the National Aeronautics and Space Administration (NASA), has over 50 years of continuous global earth observation data, allowing for long time series of remote sensing monitoring.

Remote sensing data is easy to use. In contrast to tools such as field surveys, remote sensing data is acquired on a regular and automated basis and its processing is standard and professional, not only user-friendly, but also highly error-tolerant and less prone to error.

Remote sensing data is therefore a significant advantage for both current urban research and the acquisition of urban change over time, and has received a great deal of attention from scholars.

2 Micro-module C-C1: UAV-based 3D Scanning and Mapping

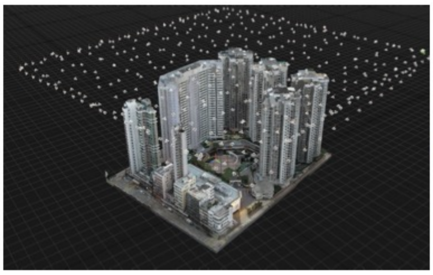
This micro-module will guide you through the essential steps in generating geo-referenced urban public space photogrammetry models using two different types of data obtaining methods, unmanned aerial vehicle scanning and terrestrial scanning.

You will learn about the technical details and techniques behind data acquisition, processing, model generation and model manipulation in this micro-module.

Introduction of photogrammetry

Types of Photogrammetry

Two general types of photogrammetry: **aerial** (with the camera in the air) and **terrestrial** (with the camera handheld or on a tripod). Terrestrial photogrammetry dealing with object distances up to ca. 200 m is also termed close-range photogrammetry. This two modes can be used in combination.



Ariel UAV Photogrammetry/

Terrestrial Photogrammetry/

Drone scanning

Automated Drone Scan Planning

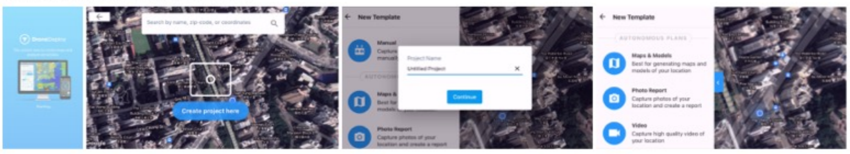
Despite the planning procedures will vary with different drones, the core idea behind the planning work will still be the same. In this planning demonstration we will be using a DJI Phantom 4 Pro v2.0, however you should refer to the official manuals of your drone for flight controls detail.

Step 1/
Once you have established the scan location, search of a take off location that satisfies the following criteria:

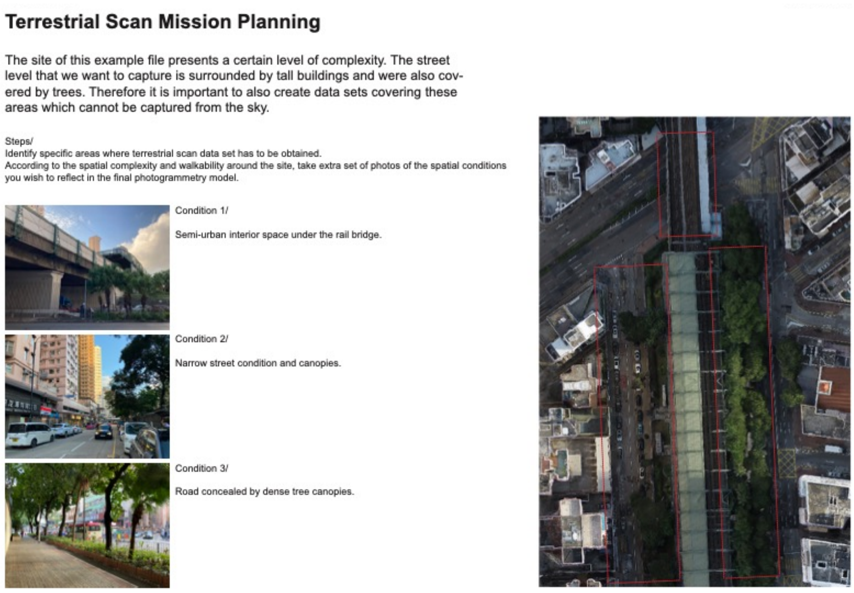
- The site shall be flat enough to enable safe take-off and landing at all times
- The operator shall maintain direct visual contact with the UAS during the period of the flight
- The site shall be clear of persons, vessels, vehicles or structures

Step 2/
Once you have established the scan location, download and open DroneDeploy on your iOS/Android device that you will use with the drone controller. Inside the app you will need to create a DroneDeploy account.

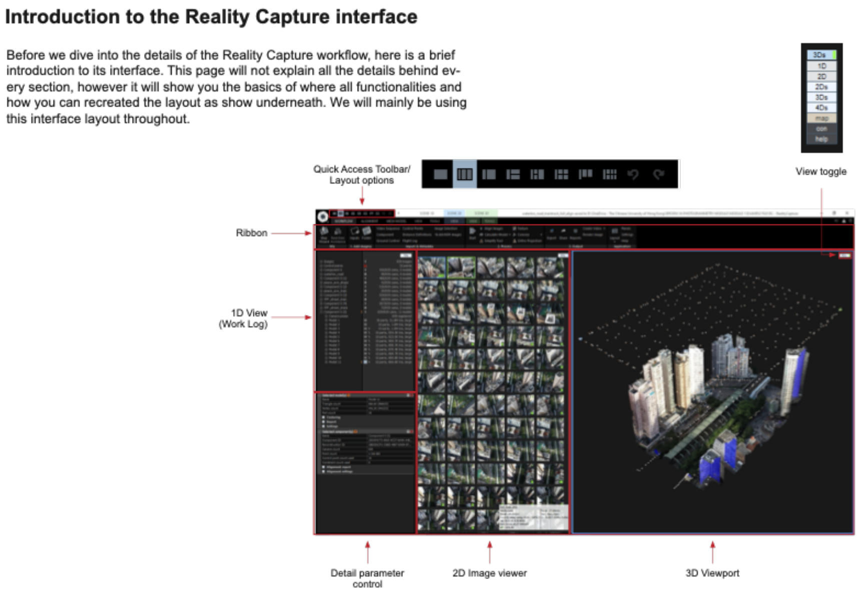
Step 3/
Start a new project, choose the **Maps and Models** plan.



Terrestrial scanning



Model generation



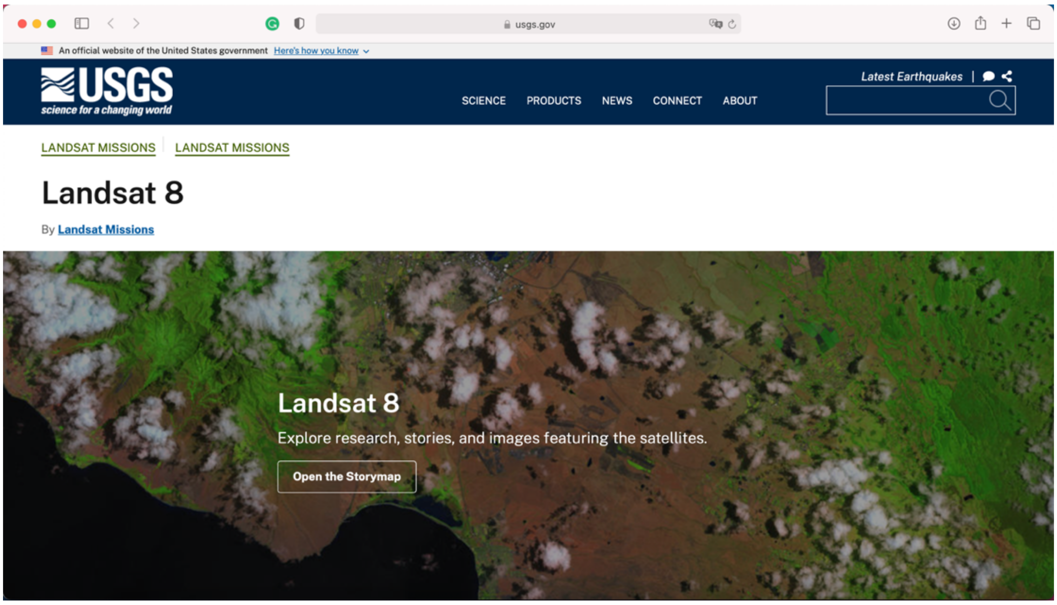
At the end of this micro-module you will be able to export the photogrammetry model into Rhino3D to benefit your architectural design and research projects.

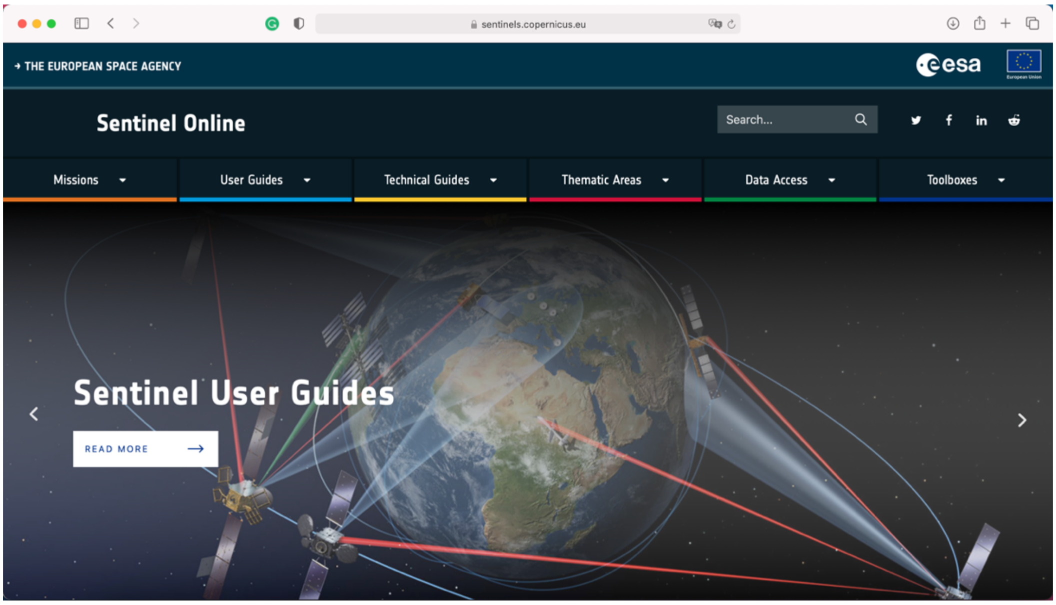
3 Micro-module C-C2: Satellite Data and Aerial Photography

This micro-module includes an introduction to the basic overview of satellite remote sensing data, methods of obtaining commonly used satellite remote sensing data and data processing methods. It includes the data downloading methods of Landsat and Sentinel and the calculation of the Normalized Difference Vegetation Index (NDVI) to determine the density of green plants within a piece of land.

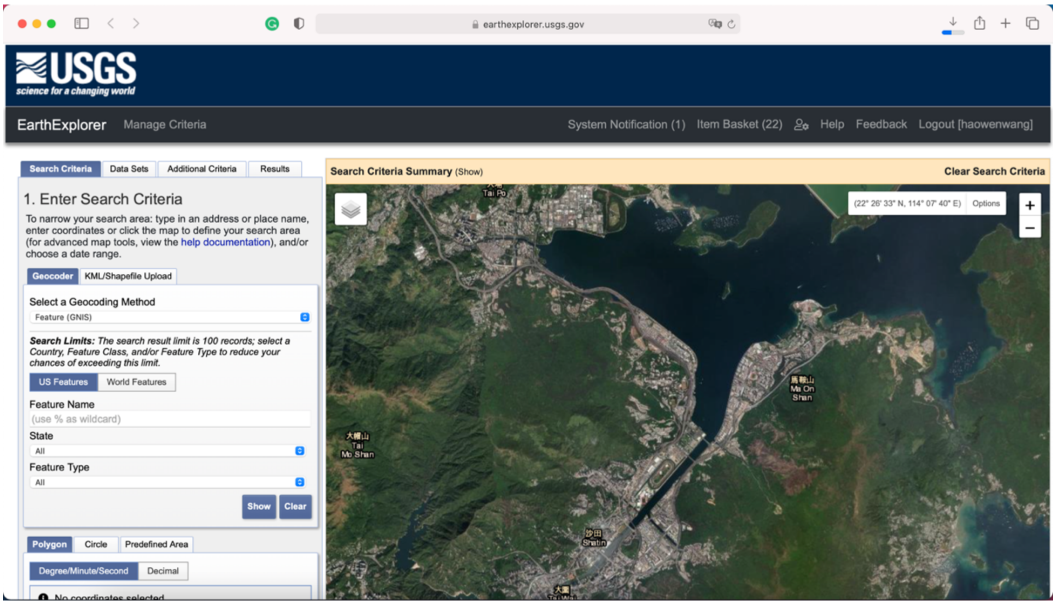
The micro-module consists of three main parts. The first and second parts including the data sources of the two commonly used remote sensing data, Landsat and sentinel, comparison of their advantages and characteristics, common software for processing remote sensing data and download methods.

Introduction of remote sensing data



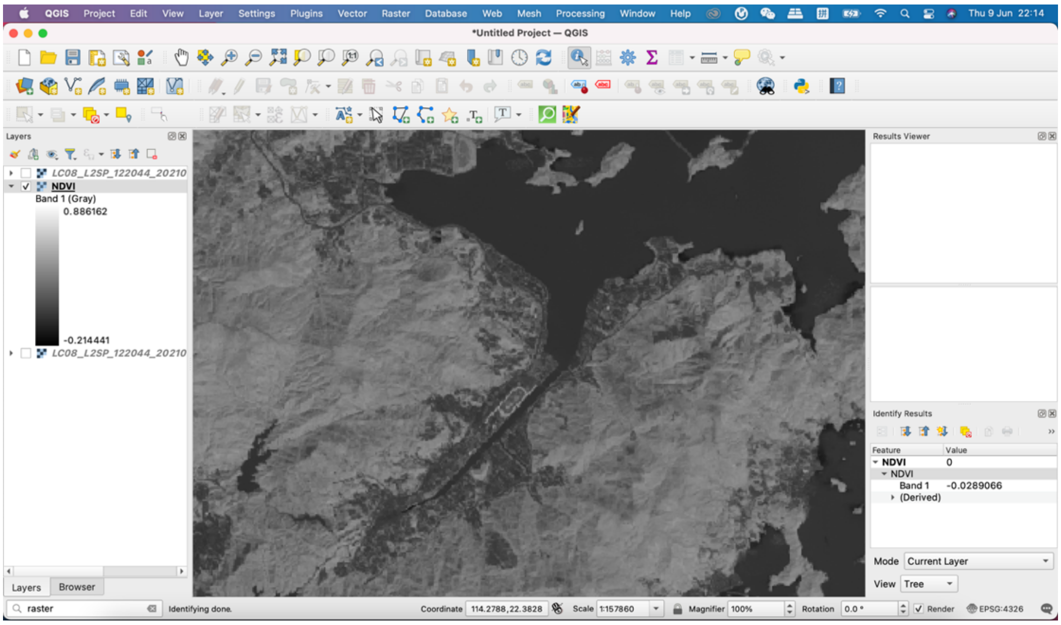


Data downloading



The third part focuses on the application of satellite remote sensing data in research, including an introduction to the concept of satellite remote sensing index NDVI, possible scenarios and calculation methods for application in urban design and social sciences.

NDVI calculation



By the end of this micro-module, you will have an overview of satellite remote sensing data and you will have gained a new approach to analysing urban problems and the current situation.