MARQUES ™
AVIATION

MA UAV Sensors & Aerial Imagery Analysis Course

Course Description: The course provides an introduction to the fundamentals of UAV Sensors and Imagery Analysis, outlining the core knowledge and techniques associated with sensor features and principles of operation, and measurements from aerial imagery. The course consists of online lectures, home exercises, and practical data collection using the participants' own UAV platform in their own location. Upon completion of this course, participants will be fully conversant with the techniques for aerial imagery analysis.

Course Contents

1. Sensors Overview
Electro-optical (EO)
Infrared (IR)
Multi Spectral Imaging (MSI)
Hyper Spectral Imaging (HSI)
Light Detection & Ranging (LIDAR)
Synthetic Aperture Radar (SAR)

2. Electro-Optical Sensors
Basic introduction to EO sensor and how best to optimise EO imagery in different environmental conditions. Unmanned vehicles rely heavily on electro-optical sensor payloads to perform their operations. These are the sensors that detect light in many different spectra, and enable unmanned vehicles to see. Electro-optical payloads are the sensors that enable unmanned vehicles to see and avoid obstacles, detect movement, and navigate accurately.

3. Infra-Red Sensors
IR Sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large jump in the intensity, which we already know can be detected using a threshold.

4. Multi Spectral Imaging
A multispectral image is one that captures image data at specific frequencies across the electromagnetic spectrum. The wavelengths may be separated by filters or by the use of instruments that are sensitive to particular wavelengths, including light

from frequencies beyond the visible light range, such as infrared. Spectral imaging can allow extraction of additional information the human eye fails to capture with its receptors for red, green and blue.

5. Hyper Spectral Imaging

Hyperspectral imaging, like other spectral imaging, collects and processes information from across the electromagnetic spectrum. The goal of hyperspectral imaging is to obtain the spectrum for each pixel in the image of a scene, with the purpose of finding objects, identifying materials, or detecting processes. Whereas the human eye sees color of visible light in mostly three bands (red, green, and blue), spectral imaging divides the spectrum into many more bands. This technique of dividing images into bands can be extended beyond the visible. In hyperspectral imaging, the recorded spectra have fine wavelength resolution and cover a wide range of wavelengths.

6. Light Detection & Ranging

Lidar is a surveying technology that measures distance by illuminating a target with a laser light. Lidar is an acronym of Light Detection And Ranging. Lidar is popularly used as a technology to make high-resolution maps, with applications in geodesy, geomatics, archaeology, geography, geology, geomorphology, seismology, forestry, atmospheric physics,[4] airborne laser swath mapping (ALSM) and laser altimetry. Lidar is frequently used for laser scanning or 3D scanning airborne applications.

7. Synthetic Aperture Radar

Synthetic aperture radar is a form of radar which is used to create two or three dimensional images of objects, such as landscapes. SAR uses the motion of the radar antenna over a targeted region to provide finer spatial resolution than is possible with conventional beam-scanning radars. SAR is typically mounted on a moving platform such as an aircraft or spacecraft, and has its origins in an advanced form of side-looking airborne radar (SLAR). The distance the SAR device travels over a target in the time taken for the radar pulses to return to the antenna creates the large "synthetic" antenna aperture (the "size" of the antenna). To create a SAR image, successive pulses of radio waves are transmitted to "illuminate" a target scene, and the echo of each pulse is received and recorded.

8. Aerial Image Analysis

Aerial photography are of special interest to cartographers who take detailed measurements from aerial photos in the preparation of maps. Maps and aerial photos present a "bird's-eye" view of the earth, however aerial photographs are not maps. Maps are orthogonal representations of the earth's surface, meaning that they are directionally and geometrically accurate. Aerial photos contain radial distortion and corrections are necessary for measurements from photographs to be accurate. This course addresses measurements form aerial photography and other aspect of image analysis.