Photogrammetrics & Robot Vision
Assignment 1

Contenido

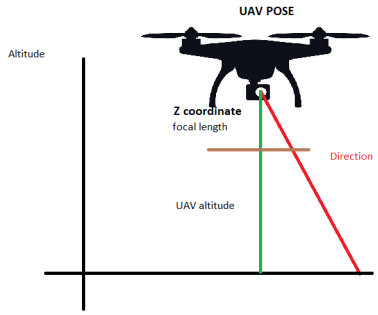
1 Context

In sea food and canning industry, the first element of the value chain is the breeding of the mussels in the coast hanging from a structure call trough.

The troughs frequently drift in the *rias*,and thus, we have to design a system based on drones for their monitoring and control their position in East North and Altitude values.

The system is composed of the following elements:

- GPS and INS that provides the position and the orientation (POSE) of the drone in a NED coordinate system and angles *roll*, *pitch*, *heading*.
- A 3-axis gimbal that is fixed after the first setting of the payload orientation .
- A Camera with known calibration parameters.



2 Objectives

The objective of this practice is to apply geometric camera calibration parameters for pixel corrections (undistort) and a spatial 3D transformation as a base for target geolocation.

3 Methodology

3.1 Spatial transformations

We have to solve the transformations from

1. The camera coordinate system to the gimbal coordinate system
2. The gimbal coordinate system to the (local) INS coordinate system
3. INS coordinate system to the World Coordinate System.
4. Do the composition of the 1-3 transformation to obtain the global similarity transformation.

Write a python script that obtains the transformation from the Camera Coordinate System to the World Coordinate System and the inverse transformation making use of functions defined on your own.

3.2 Camera calibration-undistort

We assume that the camera calibration has been previously calibrated using a frame camera model.

Using ONLY numerical libraries, write a function that obtains the coordinates in the camera coordinate system (x,y) from a pixel location in the picture (u,v).

```
define calibration parameters
read distorted pixel coordinates (u,v)
foreach distorted pixel (u,v)
  obtain estimation pixels (x',y')
  initialize estimated undistorted coordinates (x,y) as
(x',y')
  repeat
    calculate radial and tangential distortions of (x,y)
    estimate new undistorted pixel coordinates (x,y)
    calculate radial and tangential distortions of (x,y)
    estimate distorted pixel coordinates (u',v')
    compute distance error (u,v) to (u',v')
  until error bellow a threshold
```

3.3 Testing

In order to perform the tests to your code please use the following particular settings:

- Fame model of the camera parameters as in the following table

Type	Resolution	Focal Length	Pixel Size
Frame	**4000 x 3000**	**3.61 mm**	**1.56 x 1.56 µm**

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	P1	P2
K4	**-0.0275491**											
F	**2406.1**	1.2	1.00	0.44	-0.18	-0.63	0.07	-0.67	0.88	-0.74	0.01	-0.08
Cx	**25.498**	0.081		1.00	-0.13	-0.43	0.13	-0.32	0.39	-0.34	0.15	-0.00
Cy	**-33.0153**	0.073			1.00	0.03	-0.26	0.12	-0.15	0.13	-0.04	0.12
B1	**-5.67637**	0.0056				1.00	-0.06	0.49	-0.56	0.48	0.06	0.05
B2	**0.339356**	0.0044					1.00	-0.14	0.06	-0.06	-0.10	0.02
K1	**0.00247448**	6.5e-05						1.00	-0.74	0.73	0.38	-0.11
K2	**-0.0240244**	0.00011							1.00	-0.96	0.01	-0.07
K3	**0.0604812**	5.3e-05								1.00	0.02	0.04
P1	**0.000150734**	2.2e-06									1.00	-0.15
P2	**-0.000271032**	1.4e-06										1.00

- Configuration of the Camera: Nadiral orientation
- Boresighting Gimbal INS: Traslation (0,0,0.25), initial orientation of the camera as in Figure 1.
- The World Coordinate System consists of a UTM projection, East-North-Up.
- Testing values for roll, pitch and yaw are (2.5, 5, and 60) sexagesimal degrees. The order of rotations is Yaw-Pitch-Roll from the fixed WCS.

4 Deliverables

The deliverable of the exercise are the python functions and scripts developed. The preferred format for the deliverable is a Jupyter Notebook.

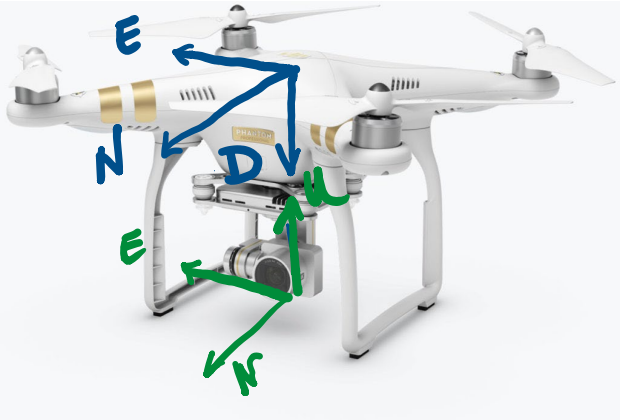


Figure 1 POSE Gimbal – INS