05_02_topography_lab

May 2, 2025

1 Introduction to Topography and Drones

Name: _____ **Date:** _____

1.1 What is Topography?

Topography refers to the **arrangement of natural and artificial features** of an area. It includes elevation, terrain, and man-made structures. Drones can help measure these features accurately.

1.2 What is the Flow Deck?

The **Flow Deck** is an add-on module for the Crazyflie drone. It includes: - **Optical Flow Sensor**: Measures horizontal motion - **Range Sensor**: Measures vertical height (altitude)

Key Variable: - range.z – Measures the **height** of the drone above ground in meters - range.front, range.back, range.left, range.right – measure horizontal distances

1.3 Activity: Measuring Classroom Topography

Objective: Use the drone to measure height changes across a path on the classroom floor.

1.3.1 Setup Instructions

1. Arrange objects (books, boxes, etc.) to create different elevation levels.
2. Connect to the drone using `cfclient`
3. Go to the **Plotter tab** and select `range.z` to plot
4. Fly the drone forward in 1-foot increments and record height (z-range)

1.3.2 Drone Setup (Simulated Example Below)

```python
from crazyflie_sim import CrazyflieSimulator
import time

drone = CrazyflieSimulator(real=True)  # set to True for real Crazyflie
drone.takeoff(0.3, 0.2)
```

```
time.sleep(2)
```

1.3.3 Reading Z-Range (Height)

```
[ ]:  # This function gives the height above ground
      z_height = drone.get_zrange()
      print("Z-range height:", z_height, "millimeters")
```

1.4 Measurement Table

Horizontal Position (ft)	Range.z Measurement (meters)
0	
1	
2	
3	
4	
5	
6	
7	
8	

1.5 Topographic Profile

Use your data to draw a topographic profile below (on paper or in a digital drawing tool).

1.5.1 Observation 1

What challenges did you face in collecting accurate elevation data using the drone, and how did you overcome them?

Your response:

1.5.2 Observation 2

If the classroom were a real outdoor landscape, how would the elevation changes impact water flow or building construction?

Your response:

1.5.3 Observation 3

How would your results differ if the floor surface were uneven or sloped instead of flat? What does that tell you about the sensitivity of the drone's sensors?

Your response:

1.5.4   Observation 4

What limitations did you observe in using the Crazyflie and Flow Deck for topographic mapping?
How could the system be improved?

Your response:

1.5.5   Observation 5

Imagine you were mapping a forest or disaster site. What additional features or sensors would you
want on your drone, and why?

Your response:

1.5.6   Observation 6

How does this activity help you understand the relationship between elevation and topographic
maps?

Your response:

1.5.7   Observation 7

How would you modify this experiment to create a 3D topographic map of the entire classroom?
What data would you need?

Your response:

1.5.8   Observation 8

How might autonomous flight (pre-programmed paths) improve accuracy in real-world drone to-
pography missions?

Your response:

1.5.9   Observation 9

Why is accurate topographical data important in fields like urban planning, agriculture, and disaster
response? Give specific examples.

Your response:

```
[ ]: drone.land(0.3)
     drone.close()
```