PHYS/ENGR 216, PHYS 226
Texas A&M University

Visual Odometry

1 Assignment

In this lab, you will be investigating gravitational acceleration. Your team has been tasked with:

1. calibrating the tracking camera to convert between pixel units to S.I. units (see section 3.1)
2. using the calibrated camera to determine a value for gravitational acceleration, g, with the equipment available (see sections 3.2, 3.3)

2 Deliverables

For your lab report, 10% of the grade will be for following the guidelines in the lab report template. Another 10% will be allocated for the Abstract and Introduction of your report. The remaining percentage will be based on your inclusion of:

- for assignment 1:
    1. *[15%]* a description of the process your team developed to convert between measured position data in pixels to the position of the object in S.I. units. This should include the method used to evaluate the uncertainty in the conversion factor.
    2. *[15%]* the equation your team developed to convert the distance between two points in pixels to the same distance in S.I. units. You should present an uncertainty along with any specific factor in your equation.
- for assignment 2:
    3. *[15%]* a description of the experiments your team performed in order to calculate a value for g.
    4. *[15%]* plots showing x and y components of:
        - position, $\vec{r}(t)$
        - velocity, $\vec{v}(t)$
        - acceleration, $\vec{a}(t)$

       as a function of time for the tracking object in your experiment
    5. *[10%]* the average acceleration and uncertainty of the tracking object used in your experiment.
    6. *[10%]* the value of g that you team calculated, along with the associated uncertainty.

3 Technical Information

3.1 Using the tracking camera

As a reminder from the last lab, to run a Python script from the terminal you can run the command:

```
python3 the_name_of_the_script.py
```

Most of the tracking camera scripts will produce some sort of output, like a .png or .csv file. The `examples` directory is write protected and will not let the script write an output to this location. In general, it is a good practice to copy the script out to a new location before running it. For the purposes of this lab, you will likely want use the script `4_track_and_print_with_camera_input.py` to take your measurements.

3.2 Air table

The Visualization Studio at your lab station is equipped with a high lift air table. This can be used to provide a low friction environment to conduct experiments in. The air table can be angled downward, providing an incline to slide objects down. There is inclinometer built into the table to measure the angle of tilt. This measurement is most accurate when the tilt as at one of the extreme values, 0° or about ~ 3.6°. You can always check the angle measurement with a meter stick and a bit of trigonometry.

3.3 Calculating g

The acceleration, a, your team measures from the tracking object sliding down the inclined plane is related to the acceleration of gravity, g by:

$$g = \frac{a}{\sin\theta}$$

where θ is the angle of inclination of the air table.