

EGR 1010 Lab MATLAB

Supplemental Instruction Assignment #1

INSTRUCTIONS:

Complete the following assignment using the template provided on the course content page on Pilot. *Please follow the instructions for submission located at the end of this document.*

PROBLEM STATEMENT:

A senior engineer is developing a new guidance & control system for a rocket-shaped projectile that is fired from a catapult-assisted launch platform. The projectile carries instrumentation that measures properties of the atmosphere and the airflow over its fuselage throughout its flight. Using the fins on the projectile for control, the guidance system is programmed to follow a predefined flight profile. This is accomplished by providing the guidance program with data related to atmospheric and flow properties, altitude, velocity, and acceleration acquired using the onboard instrumentation.

Unfortunately, it appears that the altimeter (a device for measuring altitude) on the projectile is malfunctioning and causing the projectile to become unstable during flight. As an engineering intern, you are tasked with performing some system analysis to study the magnitude of the error in the control system throughout flight. You have been provided with the following data points that were taken during the last test.

| Time (s) | Measured Height (ft) |
|----------|----------------------|
| 0.0 | 38.501 |
| 8.652 | 3896.9 |
| 16.58 | 6978.0 |
| 30.21 | 11297.9 |
| 46.78 | 14778.5 |
| 58.79 | 16026.4 |
| 67.44 | 16274.4 |
| 79.26 | 15713.5 |
| 89.43 | 14407.3 |
| 101.59 | 11643.3 |
| 108.99 | 9287.4 |
| 119.76 | 5173.1 |
| 130.50 | 124.7 |

Also, the predefined flight profile was given as:

$$h(t) = -3.62t^2 + 473.0t + 38.2 \text{ ft}$$

Your supervisor will be reviewing your system analysis. Be appropriate with choice of variable names and plot labels.

MATLAB PROCEDURES:

Complete the following procedures in the supplemental template file available in the course content on Pilot. DO NOT alter the formatting of the existing template, but rather simply add in your code where appropriate.

1. Create row vectors for both the measured time and height/altitude given in the table. Suppress the output to the command window.
2. Create a row vector for time from 0.0 to 135.0 that has increments of 1.5 seconds. Suppress the output to the command window.
3. Evaluate the predefined flight profile $h(t)$ given above using the time vector created in the previous step. Use element-by-element math and suppress output to the command window.
4. Create a plot of height versus time for both the measured and specified flight profiles. Plot both lines on the same axis. Include a descriptive title, axis labels, and a legend in the plot. Include units in the axis labels.
5. Evaluate the predefined flight profile $h(t)$ ONLY at the time values recorded during flight. Use element-by-element computations and suppress output to the command window.
6. Compute the percent error between the measured height and the predefined profile using the following equation:
$$\% \text{ Error} = \frac{\text{Measured Height} - \text{Profile Height}}{\text{Profile Height}} \times 100$$
Use element-by-element computations and DO NOT suppress command window output.
7. Create a new figure containing a plot of the percent error versus time. Include a descriptive title and appropriate axis labels.
8. How does the error behave throughout the flight? Answer this question using a comment in the script file.

SUBMISSION:

Publish your code as a pdf and turn into your lab TA.