THE UNIVERSITY OF TEXAS AT AUSTIN
Department of Aerospace Engineering and Engineering Mechanics

ASE 367K FLIGHT DYNAMICS
Fall 2024

TERM PROJECT
Due: Friday 2024-12-06 at 11:59pm via Canvas

The dimensions of the recently designed TREL rocket are shown below in Figure 1, where the tolerance on each dimension is ± 2 mm.

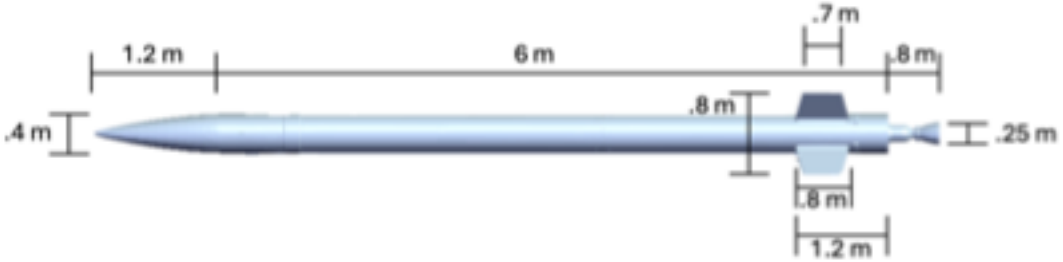

FIGURE 1: Dimensions of the TREL Rocket

The mass distribution (starting from the aft of the rocket) is given in the table below. You may assume that the tolerance on each location is ± 2 mm and the tolerance for each mass is ± 0.1 kg

Location (m)	0	0.3	0.7	1.1	1.2	2.2	2.3	2.9	3.1	3.3	3.4
Mass (kg)	0	20	25	25	20	25	70	1	10	15	1

Location (m)	4	4.2	4.3	4.9	6	6.5	6.7	6.9	7.1	7.6
Mass (kg)	20	120	1	50	5	1	5	5	10	10

Given that the rocket has a sea-level static thrust of $15.5\ kN$ and normal degradation in thrust with altitude and velocity apply:

(a) Develop a callable function that outputs the location of the center of gravity (CG) considering the effects of uncertainty in dimensions and mass.

(b) Develop a callable function that outputs the location of the center of pressure (CP) as a function of angle of attack (α) considering the effects of uncertainty in dimensions.

(c) Develop a callable function with an appropriate turbulence (e.g., Dryden Wind Turbulence Model) that outputs the winds at a given input altitude.

(d) Develop Monte Carlo simulation model for the rocket trajectory assuming no change in the location of the CG due to consumption of fuel.

(e) Use the Monte Carlo simulation model to determine whether the rocket would be stable during an ascent to $35\ km$ from the surface of a round, non-rotating earth.