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

ASE 367K FLIGHT DYNAMICS
Fall 2025

TERM PROJECT
Due: Sunday 2025-12-07 at 11:59pm via Canvas

This term project is a team project, where each team must have three (3) students. Each team must choose one of two project options. In project option 1 (the aircraft option) your team will be employed by Acme Aircraft Company to conduct flight simulations in support of the investigation into the accident of Air India 171. In project option 2 (the spacecraft option) your team will be employes by Acme Spacecraft Company in support of the design of the TREL rocket.

OPTION 1 - Acme Aircraft Company

Air India Flight 171 crashed on June 12, 2025, shortly after takeoff from Ahmedabad, India, en route to London Gatwick Airport. The preliminary investigation report stated that the cause was the fuel control switches to both engines of the Boeing 787-8 Dreamliner (VT-ANB) being moved to the "cut-off" position, resulting in a total loss of power. The report noted confused dialogue between the pilots regarding the switches, sparking a debate that is still ongoing and has led to lawsuits against the manufacturers.

Initially, because the landing gears were still extended at the time of the crash, and because amateur videos of the aircraft appeared to show that the flaps were in their stowed position, many observers speculated that the flaps had been mistakenly retracted at the time that the landing gears should have been retracted. In fact, were it not for flight data recorder data and the subsequent observation that the ram air turbine (RAT) had been deployed indicating that both engined had failed, it would have continued to be the primary suspected cause of the accident.

Perform the following tasks assuming your team of flight dynamics engineers at Acme Aircraft Company are members of the accident investigation team, and that you only have access to aircraft trajectory data, i.e., you had no flight data recorder data and thus no way to determine internal states of the aircraft:

(a) Create your “actual” aircraft trajectory data using the VR Flight Simulation Facility to simulate takeoffs of the 787-8 at MTOW under the following conditions:

   i. a nominal takeoff with no failures or mishaps
   ii. upon achieving positive rate of climb, the flaps are retracted instead of the gears
   iii. upon achieving positive rate of climb, the fuel flow to both engines is cutoff

(b) Use publicly available data and the data for the 787-8 in X-Plane to develop your own numerical simulation for the 787-8 and use it to simulate takeoffs of the 787-8 at MTOW under the aforementioned conditions.

(c) Verify that your numerical simulation produces representative trajectories by comparing the nominal trajectory you derive from your numerical simulation to the nominal trajectory you derive from the VR Flight Simulation Facility.

(d) Determine whether you can distinguish between the two potential causes of the accident by comparing the failure trajectories you derive from your numerical simulation to the failure trajectories you derive from the VR Flight Simulation Facility.

(e) Provide a short report (less that 10 pages) summarizing your findings.

OPTION 2 - Acme Spacecraft Company

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

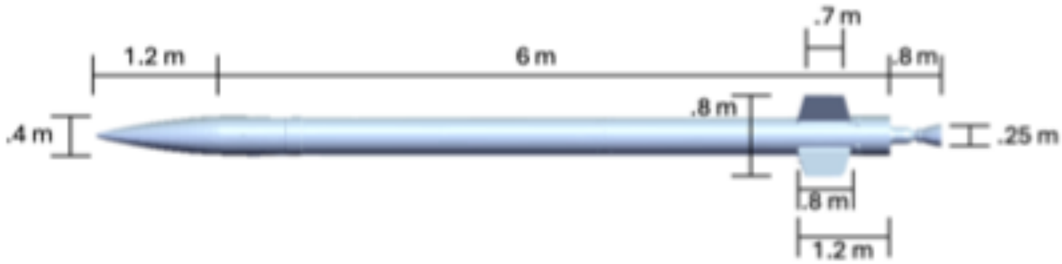

FIGURE 1: Dimensions of the TREL Rocket

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 callable functions that output the location of the center of gravity (CG) and the location of the center of pressure (CP) as a function of angle of attack (α) considering the effects of uncertainty in dimensions and mass.

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

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

(d) Use the Monte Carlo simulation model to determine whether the rocket would be stable (or where weight should be added to the rocket to make it stable) during an ascent to 35 km from the surface of a round, rotating earth.

(e) Provide a short report (less that 10 pages) summarizing your findings.