Arizona State University at the Polytechnic Campus
Department of Engineering
EGR 301 – Fall Concentration Project for Mechanical Systems

Project Assignment – Fall 2012

A sounding rocket is often used to conduct scientific experiments, such as weather data collection, using the instrument it carries. Its flight is sub-orbital and can usually reach altitude higher than the capability of most weather balloons at much lower costs than satellites. Since most inexpensive sounding rockets are unguided, their flight trajectories are solely decided by their design and launch conditions, such as launcher's orientation and wind conditions, etc. It is very important that a commercial company offering sounding rocket launch services can accurately predict the trajectories to ensure that they pass over the target zones for data collection.

Your team will participate in a project to design, through engineering analysis and computer simulation, build and launch a solid-propellant powered sounding rocket system that meets the following requirements and constraints:

Constraints

1) A payload component is necessary and it should be easily detachable for independent weight check before each field test launch.

2) The solid-propellant propulsion system's total impulse has to be less than 20 N-s. It is each team's responsibility to demonstrate that the constraint is met at the day of the final competition launch.

3) A computer simulation model and corresponding analysis of the rocket flight dynamics must be developed, documented, reviewed, verified and validated, and approved before a team can proceed with the field tests.

4) The total budget for the complete design, fabrication and operation of this project should NOT exceed $250 for each team.

Criterion

Each team should design a rocket and plan its trajectory, through adjustment of launcher orientation and payload, to hit a hypothetical target in computer simulations. The level of simulation model's complexity will increase incrementally through out the semester by incorporating more flight dynamics details into the analysis/simulation model. The design goal is to deliver a payload, which accounts for at least 20% of the rocket's total mass, to

ANY target located between a given minimum and maximum distance from the launch point, using a launch rail that is pointed within 30 degrees from the vertical.

In addition, field tests will be conducted in which the accuracy of each team's simulation results and rocket design will be evaluated based on the following criterion

a) The average difference between the actual landing spots of 10 launches by each team and the target point, which will be announced 24 hours before the start of a scheduled field test.

b) Percentage of flights that fall within each team's impact circle, as predicted by its computer simulations, around the target point

c) The weight of the payload a rocket carries, as a percentage of the rocket's total weight.

d) The robustness of a rocket's design i.e. percentage among the flights in which all the components, including the payload, of the rocket survive the launch and landing process.

Helpful Resources

Model Rocketry and Engines: www.estesrockets.com