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APOGEE PEAK OF FLIGHT NEWSLETTER

The Moving Target Called "Optimal Delay"

By Tim Van Milligan

This week's feature article comes as a discussion that was started by a question. Here is the question:

> *I noticed something weird in Rocksim5.02. When I sim'd it with a 1/2A3-4T sustainer, it said I the optimal delay would be 4.58 secs. So, I changed the delay to 4.5 and re-sim'd. It then said the optimal delay should be 4.78 secs. I then changed the delay to 4.7 and had it tell me the optimal delay is 4.8. It seems the optimal delay is a moving target. Is this a bug? Your feedback is appreciated. -- Doug Sams*

It took me a while to figure out. But RockSim is doing everything right.

Here is what is happening.

The first thing, you're deploying the parachute prior to apogee.

At ejection, RockSim automatically and instantaneously changes the C_d of the rocket. It goes from the relatively low value which occurs when the nose cone is still on, to a high value of the parachute. It also switches reference area for calculating the total drag of the model. This goes from the diameter of the body tube, to the diameter of the parachute.

But since your deploying the parachute prior to apogee, the model still has some upward velocity. This velocity must decrease to zero before it can change to negative (which is defined as descending).

So here is what is happening. The model is going upward, and deployment occurs. The drag rises dramatically because the parachute is deployed; and in effect is trailing out the back of the rocket But it is still continuing upward. It must go upward until the velocity goes to zero (apogee point).

The optimum delay value you are seeing is how long it takes from engine burnout to the point of apogee. You've made the assumption that the optimum delay value would have been the time from burnout to when the rocket reaches apogee -- IF -- the parachute hadn't been deployed prior to apogee.

But RockSim doesn't calculate it that way when you deploy prior to Apogee. If you want the true value of the optimum delay, you need to deploy the parachute after apogee. For example, if you started with a delay of 8 seconds, it it tells you 4.86 seconds; that would be a true value. If you then typed in a delay of 4.86 seconds the next time, you'd get the an optimum delay of 4.86 seconds.

In each sequence of your simulations, you were always ejecting prior to 'true' apogee. So it appeared to be a moving target. Had you gone over the top and cut it short, you'd have found the answer quickly.

Don't feel bad. Like I said, it took me about 40 minutes to discover the same thing. I finally figured it out when I looked at the 2-D flight profile with the details displayed to the right side. As I incremented the flight time (using the left & right arrow keys on the keyboard), I saw the model going upward, with the parachute deployed (the picture was upside down). As I incremented it one more time, it was still going upward. The flight profile is one of the most useful features of RockSim when it comes to de-bugging a simulation.

About the Author:

Tim Van Milligan is the owner of Apogee Components (http://www.apogeerockets.com) and the curator of the rocketry education web site: http://www.apogeerockets.com/education. He is also the author of the books: "*Model Rocket Design and Construction," "69 Simple Science Fair Projects with Model Rockets: Aeronautics"* and publisher of the FREE e-zine newsletter about model rockets. You can subscribe to the e-zine at the Apogee Components web site, or sending an email to: ezine@apogeerockets.com with "SUBSCRIBE" as the subject line of the message.

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