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APOGEE PEAK OF FLIGHT NEWSLETTER

Simulating Dual Deployment Rockets in the RockSim Software -- Part 1

By Tim Van Milligan

In this two-part article, I will talk about how to simulate dual deployment rockets in the RockSim software. Part one will attempt to explain what makes dual deployment very complicated to simulate, and the second part will give you some tips to use to get around some of RockSim's limitation.

First, let me give you a little background.

The rise of electronic payloads in high power rockets has also led to an increase in the use of dual-deployment parachute strategies. For example, many modelers are flying altimeters, timers, accelerometers, and other flight computers on their rockets as a payload. Many of these devices have the capability to eject parachutes out of the rocket. And they can eject more than one chute out, and at different times during the flight.

For those of you that are unfamiliar with what dual-deployment is, I'll give you a short explanation. The overall objective of dual-deployment is to recover your rocket as close to the pad as possible. This lessens the chance of losing the rocket; particularly on rockets that fly high and may drift long distances.

To recover as close to the pad as possible, it stands to reason that you want the rocket to descend quickly, to lessen the chances of drifting away in the wind.

However, you don't want the rocket to descend too quickly, or it could be damaged on landing. The optimum would be to deploy a small parachute (called a drouge chute) at apogee, and then to deploy the big main chute at a lower altitude. Because the big chute doesn't blossom until the rocket is low to the ground, it won't drift nearly as far. Since there are two recovery devices released at different times during the flight, it has been given the name "dual deployment."

When it comes to simulating dual deployment in RockSim, I've seen a lot of confusion. There have been more than a few people that think if you just put two parachutes into the design, then RockSim will automatically perform the simulation as a dual-deployment system.

Unfortunately, as advanced as RockSim is, I wish it was this easy to simulate. Actually, putting more than one recovery device into the rocket design only complicates things for RockSim. To illustrate the challenges RockSim faces with multiple chutes (or streamers), consider a three stage rocket; with each stage using dual deployment. Maybe the upper stage also has a cluster of parachutes...

From RockSim's point of view, prior to ejection, the rocket has a given drag coefficient (approximately .75), and a set reference area that it uses to calculate the overall drag of the model on its upward ballistic trajectory. And after deployment, it switches to the C_d of the parachute and a different reference area to find the drag of the descending model.

What is confusing and complicated to RockSim -- when multiple parachutes are inserted into the design -- is "which" parachute to use as the recovery device for calculating descent and drift rate information?

In our example of the three stage rocket; should RockSim use the booster chute, the upper stage chute, the drouge chute, the one in the middle, the one in the back? Etc... As you can see, it is complicated.

What has been our minds is that we need some type of user interface to set up a deployment sequence for the various recovery devices in the vehicle. Such of interface would be like the one for loading motors into the rocket. You'd select a recovery device, and then you'd have to tell RockSim when in the flight sequence you'd like it to deploy. In effect, every recovery device loaded into the rocket would have to be assigned its own deployment timetable.

Our first dilemma is that is that if we knew where in the flight sequence to deploy the parachutes, we wouldn't need

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RockSim. We're specifically using RockSim to find out this information. DUH...

Second, there are many dual deployment scenarios where there isn't a drouge parachute or streamer in the rocket at all. "Huh?" you ask.

For example, one purpose of the drouge chute is to shift the rocket out of a ballistic trajectory. It doesn't take a drouge chute to do this. All you need to do is eject the nose cone off the rocket. The shift rearward of the model's CG is often enough to cause the rocket to start tumbling down. This may be just as slow as a rocket with a small drouge chute. How would RockSim account for this? I don't know.

A tumbling rocket is a very complicated simulation. The Cd and the reference area use to calculate drag are constantly and radically changing.

As an aside, (in RockSim) the tumbling rocket scenario is the main reason we don't allow parachutes to be placed in booster section of multi-stage rockets. We figure that the reason you'd put a parachute in the booster section is to find out where it lands with respect to the rest of the rocket. That would be easy. But if the booster section uses tumble recovery, we don't have a good way to simulate its Cd or a reference area to calculate drag. Without that, we can't find out its falling speed or where it will land.

To keep from getting into complicated situation like this (until we figure out how to simulate a tumbling rocket) we decided to just prohibit parachutes in the booster sections of multi-stage rockets. If your rocket design has a parachute, then you have to simulate it as a "mass object." While we can't tell you where it might land, at least as a mass object we can tell you how it will affect the overall CG of the rocket on the boost trajectory.

Summing up this first article: At this point, we haven't figure out a easy way to display the specific information RockSim needs for each parachute in a dual deployment situation. If it was just two parachutes, it would be easy. But since I've seen some pretty complex designs from RockSim users, I know that we'd have to account for some really sophisticated designs.

In the next article, I'll give you some tips and tricks you might use to get "some" of the information you might be looking for. Like, where the rocket will land, and how long it will take for it to fall.

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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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