PEAK OF FLIGHT NEWSLETTER

ISSUE 474 | July 24th, 2018

IN THIS ISSUE

Ejecting Rocket Motors in RockSim

www.ApogeeRockets.com/Rocket-Kits/Skill-Level-5-Model-Rocket-Kits/Stratus-Gale

Apogee Components, Inc.
Your Source For Rocket Supplies That Will Take You To The "Peak-of-Flight"
4960 Northpark Drive Colorado Springs, Colorado 80918 USA
www.ApogeeRockets.com e-mail: orders@apogeerockets.com Phone: 719-535-9335 Fax: 719-534-9050

Ejecting Rocket Motors in RockSim

By Tim Van Milligan

A customer wrote us: “I found plans for couple really small rockets, the Mosquito and the Streak. Is there a way in RockSim to pop out the motor and just let the rocket tumble down?”

Since the Estes Mosquito doesn’t have a recovery device in the rocket, that makes this design much simpler than if you wanted to eject the nose cone by itself (which is described in TARC tutorial video #6). You’ll find that the easiest way to eject a rocket engine is to set the design up as a two-stage rocket. So I’ll walk you through the step on what I experienced when I did it because you’ll probably encounter the same issues that I did. They weren’t really “issues,” just things that I forgot about since I learned the program.

The first thing you’d do is to design the rocket as you normally would in RockSim. The Mosquito is a simple rocket consisting of just four parts: nose cone, body tube, fins, and a launch lug.

The component tree in RockSim looks like **Figure 1**.

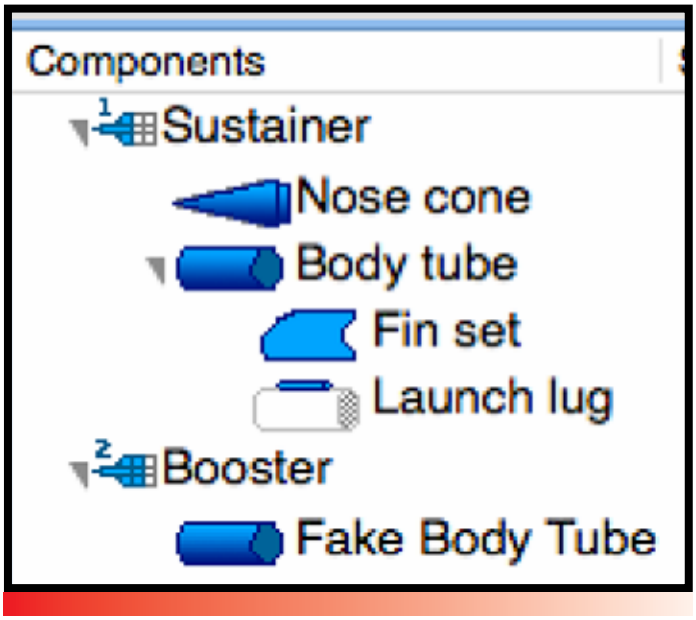


Figure 1: The component tree of RockSim.

If you load the engine and run a simulation at this point, the rocket really flies high. Because it weighs so little, the rocket reaches over 930 feet in altitude (simulation #1 in **Figure 3**). I personally don’t think that is realistic, even if the rocket weighs so little. It is a high drag model based on my experience, so I went ahead and did a Coefficient of Drag override of 1.25 to make it a more realistic altitude of about 400 feet.

At this point, the way the rocket is set up, the engine will stay in place throughout the entire flight. It won’t be spit out. On the simulation, the ejection charge goes off, the rocket will simply come down to the ground.

When I looked at it in the flight profile, the rocket is still stable with the motor installed (but burnt out), so it comes down fairly straight. It is pretty slow because the drag coefficient is high and the rocket is very lightweight.

Figure 2: The rocket descending.

Notice in **Figure 2** that the rocket isn’t pointed straight down. It is lightweight enough that it is being affected by the wind. The descent rate, which you can get from the graphs, or from the details in the 2D flight profile is around 36 mph. Now, this is a bit fast. This is why we do want to lighten up the rocket so it comes down slower.

My next step was to make the rocket into a two-stage rocket.

Here is the little trick. We’re going to use one component in the bottom (called the booster). The one component is a very short tube (see **Figure 1**). Its sole purpose is to hold the motor. What is unique about it is that we’ll make it very short. I set the length as 0.01 inches - which

Continued on page 3

About this Newsletter

You can subscribe to receive this e-zine FREE at the Apogee Components website **www.ApogeeComponents.com**, or by clicking the link here Newsletter Sign-Up

Newsletter Staff

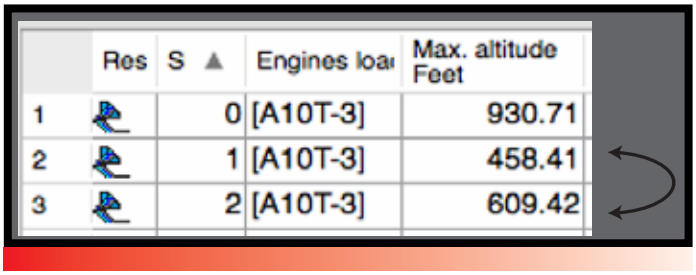
Writer: Tim Van Milligan
Layout/Cover Artist: Chris Duran
Proofreader: Will Franks

Ejecting Rocket Motors in RockSim

Continued from page 2

is about as thick as a piece of index card paper. The reason for making it so short is to minimize the weight and the effect it might have on the CG location. Essentially, we're making it so small that it is almost non-existent. It really isn't going to affect the altitude of the rocket.

But when I ran the simulation, I was shocked to see that the altitude of the rocket increased (see **Figure 3**).



	Res	S ▲	Engines loa	Max. altitude Feet
1		0	[A10T-3]	930.71
2		1	[A10T-3]	458.41
3		2	[A10T-3]	609.42

Figure 3: The altitude from simulation went up from 458.41 feet to 609.42 feet. Something is set-up wrong here.

What I had forgotten to do in the software was to adjust the Coefficient of Drag for the rocket that was a two-stage configuration.

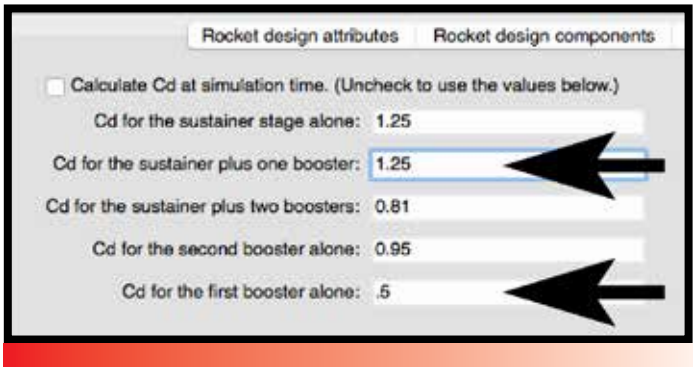


Figure 4: Since I had turned on a manual value for the Cd in the previous simulation, I forgot that the Cd must be changed for the two-stage configuration too.

On the "Cd override" tab, you have to input a number for the "Cd for the sustainer plus one booster." This should be identical to the "Cd for the sustainer stage alone." In my case, I had to input a value of 1.25 for both lines in RockSim.

Also, note that I changed the value of the "Cd for the first booster alone" to 0.5. This is the drag coefficient value for the booster stage that rockSim will use to compute the value of it as it separates and flies alone from the sustainer stage. In this case, it will be the Cd for the falling rocket motor.

Continued on page 4

Check out our Facebook page
www.facebook.com/ApogeeRockets

Ejecting Rocket Motors in RockSim

Continued from page 3

When I looked at the plot of the flight (**Figure 5**), the Booster 1 velocity was zero. That tells me that I have plotted the wrong booster. Booster 1 is the bottom-most booster. What I should have plotted on the graph is Booster 2 Velocity.

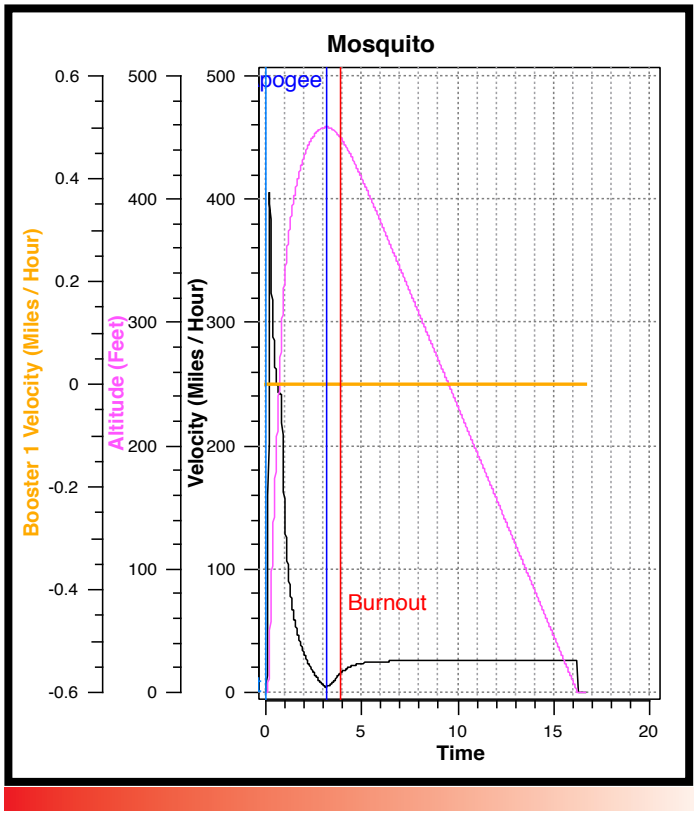


Figure 5: Plot of the flight with the booster attached. You can see that the booster 1 speed is zero, which means something is wrong.

This little check to confirm which booster is being calculated also tells me that instead of changing the Cd for the first booster, I should have changed the one called "Cd for the second booster alone" if I want to get the speed of the falling booster (the falling motor).

You might be asking, "What is a good Cd value for a falling rocket motor?" That is a great question, unfortunately, I don't know. You have to assume that it is tumbling, and the Cd is constantly changing depending on the orientation it is falling. In that case, you have to find an average Cd value.

Figure 6 shows the correct selection of Booster 2 instead of Booster 1 velocity.

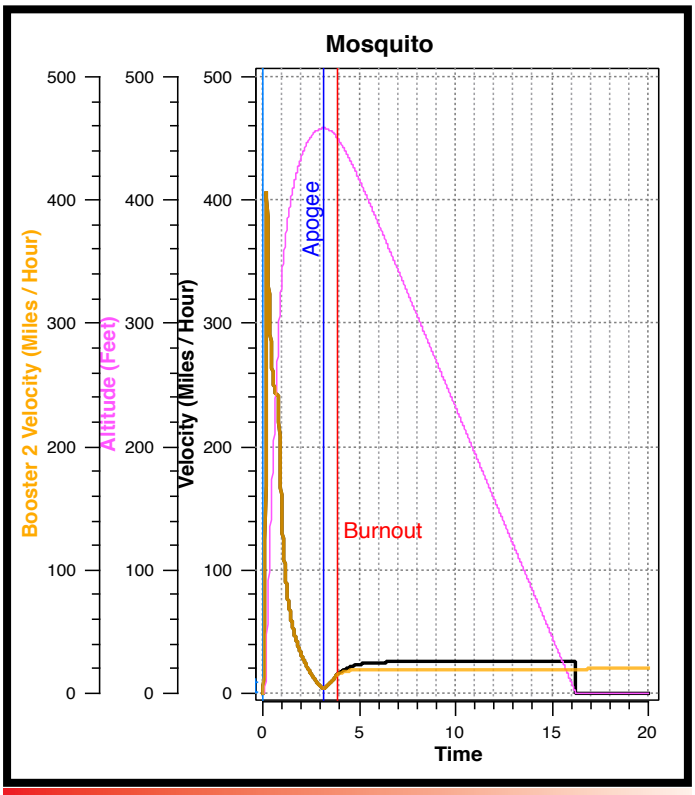


Figure 6: Plot of the flight, but this time with Booster 2 speed shown correctly.

At this point, we've got the simulation set up correctly to eject the rocket motor out of a Mosquito rocket and it was very simple to do really. The process involves creating a fake booster stage so that the motor can be ejected.

Continued on page 5

Ejecting Rocket Motors in RockSim

Continued from page 4

The Mosquito is a simple design, but simulating it in RockSim is a little more complex.

But as you can see, it can be done if you think a little bit outside the box. You also saw that even I make mistakes and forget things when I run simulations. What I wanted to show you in this article was that if you think through things systematically and logically in Rocksim, you can do some incredible things!

About The Author:

Tim Van Milligan (a.k.a. "Mr. Rocket") is a real rocket scientist who likes helping out other rocketeers. He is an avid rocketry competitor and is Level 3 high power certified. He is often asked what is the biggest rocket he's ever launched. His answer is that before he started writing articles and books about rocketry, he worked on the Delta II rocket that launched satellites into orbit. He has a B.S. in Aeronautical Engineering from Embry-Riddle Aeronautical University in Daytona Beach, Florida, and has worked toward an M.S. in Space Technology from the Florida Institute of Technology in Melbourne, Florida. Currently, he is the owner of Apogee Components (http://www.apogeerockets.com) and also the author of the books Model Rocket Design and Construction, 69 Simple Science Fair Projects with Model Rockets: Aeronautics and publisher of the "Peak-of-Flight" newsletter, a FREE e-zine newsletter about model rockets. You can email him by using the contact form at https://www.apogeerockets.com/Contact.