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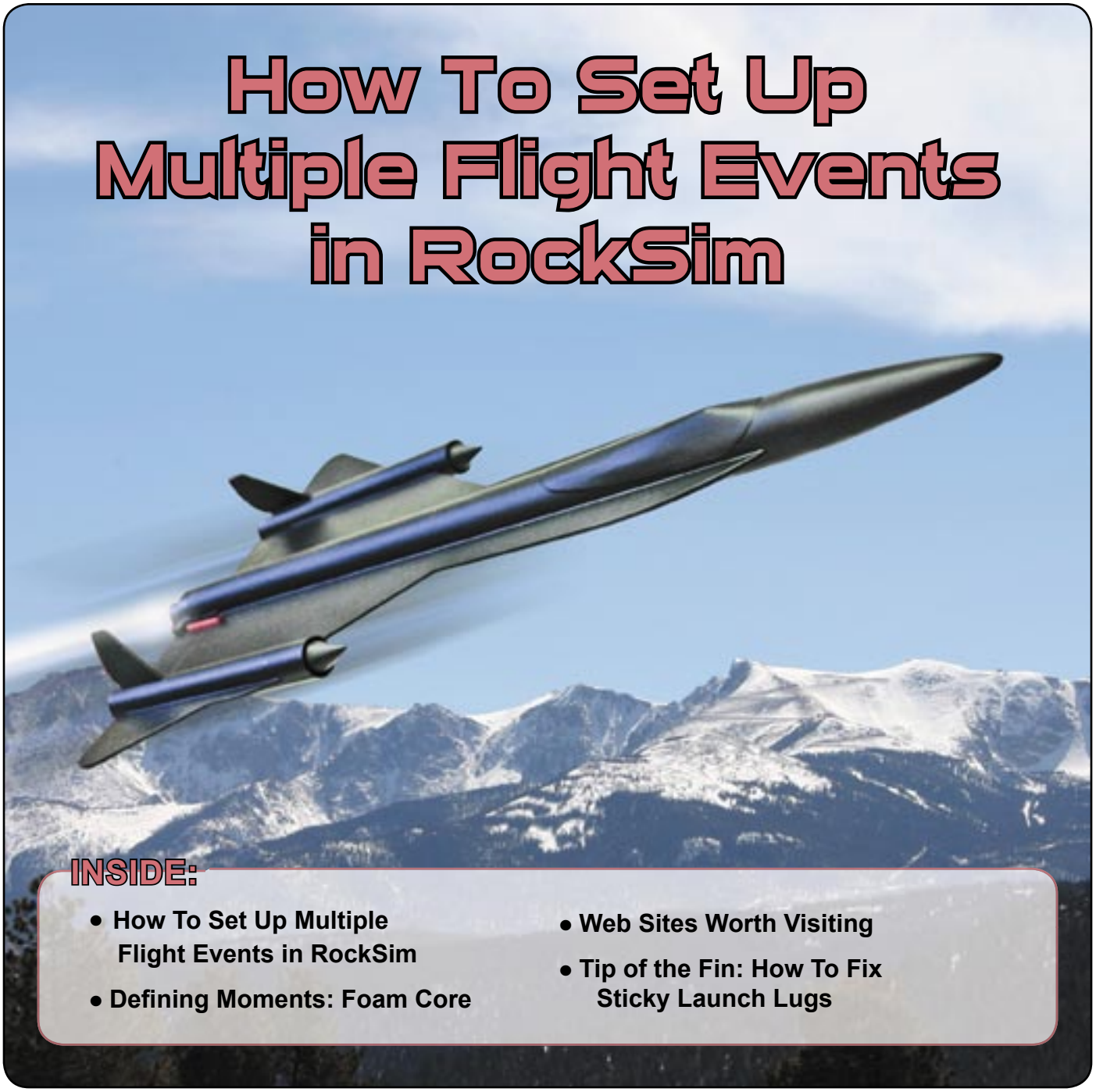
APOGEE PEAK OF FLIGHT NEWSLETTER

How To Set Up Multiple Flight Events in RockSim



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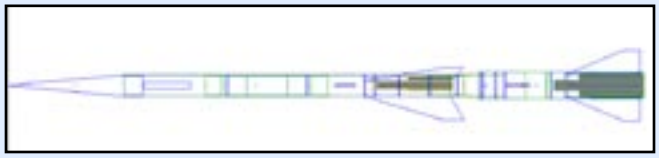
How To Set Up Multiple Flight Events in RockSim

by John Manfredo

If you have a complicated rocketry project that has multiple electronic events included in it, there are ways to tell RockSim to do just what you want it to do.

To start off, we will look at a large project and its events which will illustrate this situation perfectly in **Picture 1**. You will see a high power rocket design from



Picture 1

RockSim. This particular design is a two-stage model with central motors in both stages and clusters in both stages. This means that the main motor for each stage is in the middle, and then there are multiple motors that surround them, which will ignite at a predetermined point in the flight.

The Motors and Deployment

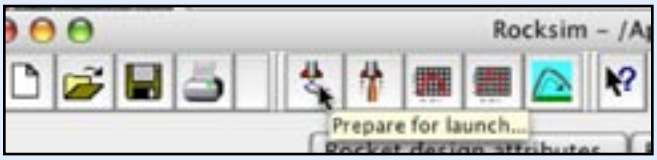
The booster stage in this particular configuration has a central M1297 motor with six J570 motors that surround it. The upper stage has three I200 motors that surround a central K700 motor. Each stage has parachute recovery with the upper stage having a dual-deployment setup. The plan for the booster is to ignite the M1297, followed by the six J570's two seconds after the rocket goes into the air. A parachute will recover this stage safely after the two stages separate.

Next, the upper stage K700 needs to ignite two seconds after stage separation. This will be followed by the cluster of three I200's firing to take it to about 18,500 feet above the ground. At that point, the smaller drogue parachute is deployed and finally, the main parachute pops-out at 1200 feet in altitude. All-in-all, there are eight different events that need to take place for this flight to work right:

- Central sustainer motor ignites
- Sustainer cluster ignites
- Stage separation
- Booster parachute deployment
- Sustainer central motor ignites
- Sustainer cluster ignites
- Sustainer drogue parachute deploys
- Sustainer main parachute deploys

Beginning the Process

The best place to begin is by loading the motors into the design, so I will go into the "Prepare for launch" screen by clicking on the button as seen in **Picture 2**. After loading the motors in each stage, I set the ejection delays and ignition delays as follows:



Picture 2

The Booster

The central motor in the booster has no ignition or ejection delay due to the fact that I need it to fire right away. Each of the motors in the booster cluster are set with a 2 second ignition delay so that they will start burning shortly after launch. The ejection delays for all of the cluster motors are set at 2 seconds as well. If the motor you are setting a delay on doesn't have the delay that you want, just highlight the delay space (see **Picture 3)**, and type in the delay you want. Then,

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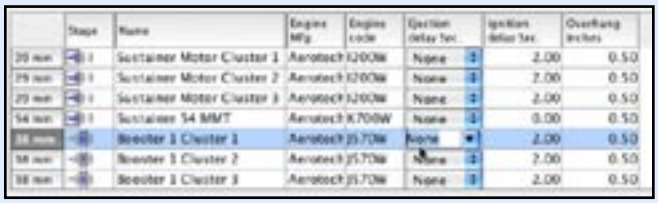
click on the "Return" key on the keyboard. This will save your setting. The 2 second ejection delay will give me 2 seconds from booster stage burn-out until the sustainer motor fires (it seperates the stages too).

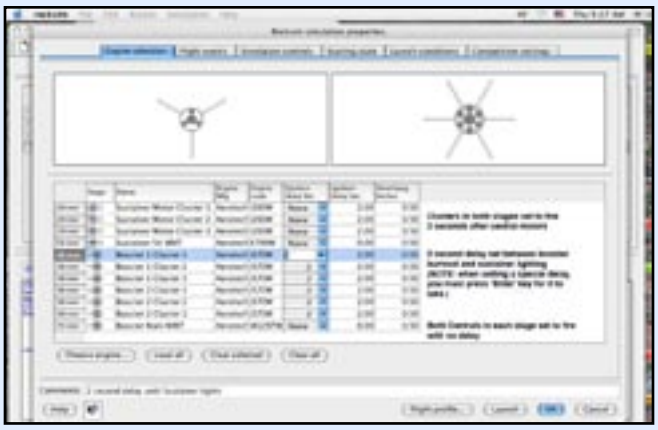


	Stage	Name	Engine Mfg.	Engine code	Ejection delay Sec.	Ignition delay Sec.	Overhang inches
29 mm	1	Sustainer Motor Cluster 1	Aerotech	I260W	None	2.00	0.50
29 mm	1	Sustainer Motor Cluster 2	Aerotech	I260W	None	2.00	0.50
29 mm	1	Sustainer Motor Cluster 3	Aerotech	I260W	None	2.00	0.50
54 mm	1	Sustainer 54 MMT	Aerotech	K700W	None	0.00	0.50
38 mm	1	Booster 1 Cluster 1	Aerotech	J570W	None	2.00	0.50
38 mm	1	Booster 1 Cluster 2	Aerotech	J570W	None	2.00	0.50
38 mm	1	Booster 1 Cluster 3	Aerotech	J570W	None	2.00	0.50

Picture 3

The Sustainer

Now comes the time to set the events in the sustainer. The central motor in the sustainer gets no ignition delay, but the cluster of three receives a 2 second ignition delay so that they start *after* the main motor. As far as the ejection delays in the sustainer go, they are set at "none". **Picture 4** shows the settings that I have done so far.



Picture 4

Flight Events

Now we need to set the flight events for each of the parachutes and their deployment. There are several options which can be used. For our purposes, the settings will be as follows. The booster will be set to deploy 2

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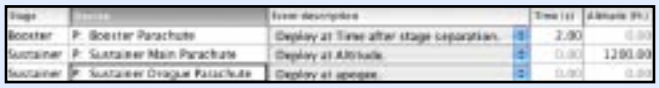
seconds after stage separation, the sustainer drogue parachute is set to deploy at apogee, and the sustainer main parachute at 1200 feet before touchdown. **Picture 5** illustrates these.



Stage	Event	Event description	Time (s)	Altitude (ft.)
Booster	P: Booster Parachute	Deploy at Time after stage separation.	2.00	0.00
Sustainer	P: Sustainer Main Parachute	Deploy at Altitude.	0.00	1200.00
Sustainer	P: Sustainer Drogue Parachute	Deploy at apogee.	0.00	0.00

Picture 5

Now that all the events are set, it's time to get this project off the ground, so to speak. Select the launch button and let the simulation take its course. Once the simulation ends it is time to examine the data to see if all of the events went as planned.

Setting Up the Graph

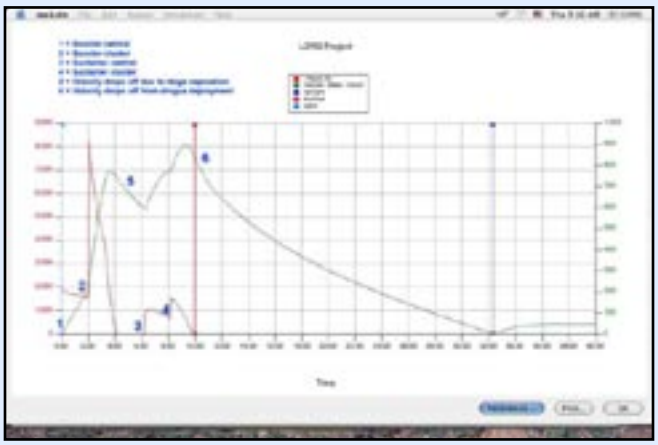
Graphs are an incredible source of information. You just have to know how to set up a graph for the particular information you want to glean from it and also how to interpret the data once you have it displayed.

For this situation, I want to see three things on the graph. The first is time, of course. I need to see the information over a given period of time to see how it changes. The second is thrust, so that I can recognize when each motor fires. The third and last label I need is velocity. This help identify the speed changes relating to parachute deployment. I will also need to set the graph data starting point to "0" and the graph data ending point to "40 seconds". These settings are seen in **Picture 6**. Once all the settings are in place, I am ready to generate the graph.

Picture 6

Examining the Data

I click on "plot graph", and RockSim will generate a graph based on the flight and data that I asked for. **Picture 7** shows what the graph looks like (The blue numbers and associated legend were inserted by myself for your benefit so that you would be able to see the explanations better).



Picture 7

As you can see, the red line indicates the thrust and the green line indicates the velocity. At point 1 on the red line, the central motor in the booster is indicated as having started by the increase in Newtons, which are listed on the left side of the graph. At point 2, the red line deviates from its path at 2 seconds which indicates that the cluster fired okay. At about the same point you can see how the green velocity line shifted a bit as well. This backs-up the evidence for the cluster firing, thus changing the velocity.

The gap just before point 3 and the drop-off in the velocity at point 5 indicates the slowing of the rocket prior to stage separation and booster parachute deployment. Just after this gap at point 3, the sustainer central motor lights causing stage seperation; and there is another increase in velocity. At point 4 and the associated velocity line, there are more increases which show the sustainer cluster firing. Point 6 shows the drop-off in speed of the rocket indicating that the sustainer motors have burned out and the rocket is slowing down.

The drogue parachute coming out is at a little over 30 seconds, which is shown as a change in the velocity

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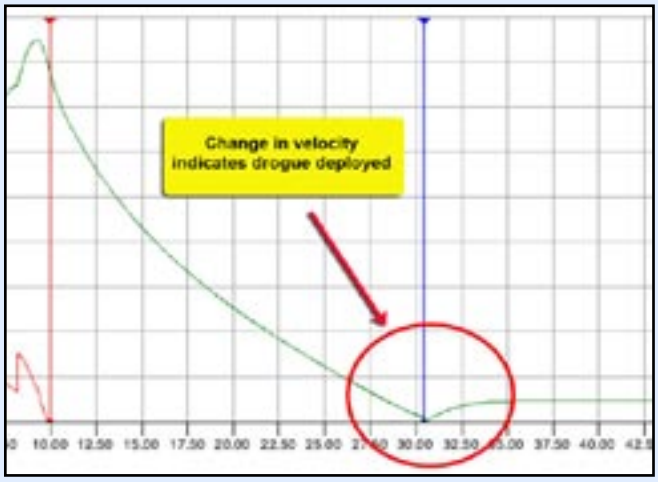
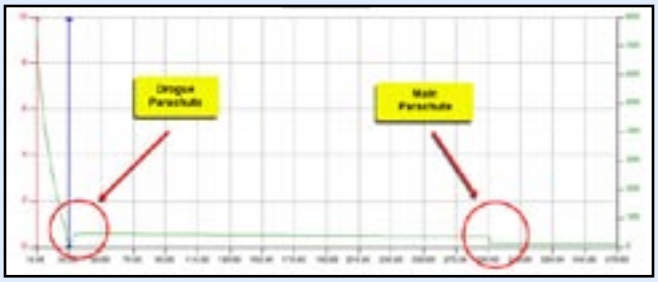


Picture 8

of the rocket again. This is shown in **Picture 8**. Looking a little further down the line there is indication of the main parachute deployment at about 290 seconds and can be seen in **Picture 9**.



Picture 9

To Sum It All Up

Now that all the data has been examined, I can see that all of the flight events have worked flawlessly. As I said before, the graph in RockSim can be a powerful tool when used in the right way. This is the reason for doing an article like this; so that your RockSim skills can "take off"!

If you haven't tried this powerful software yet, please go to http://www.apogeerockets.com/rocksim.asp, take a look, and download the demo! You will quickly find out that this design and simulation software is something you can't be without.

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TIP OF THE FIN

When you put your rocket on the launch pad, make sure it slides easily both up and down the rod. If it gets stuck going down the rod, this usually means that it will get stuck on the way up as well. This has the potential to become dangerous if the rocket becomes stuck at liftoff and it tips the pad over. A little sanding on the rod or the inside of the launch lug(s) will help prevent this and insure a flawless lift-off. Always perform this check prior to launch.

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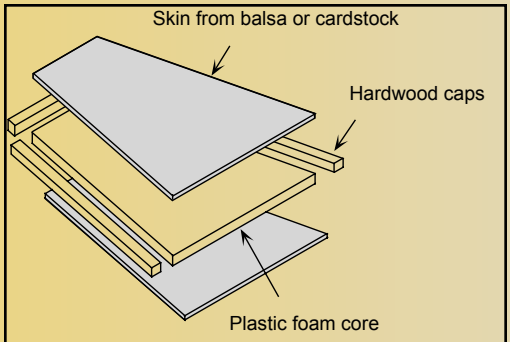
DEFINING MOMENTS

A ***Foam Core Fin*** increases the strength of a fin without significantly increasing its mass. You can insert expanded polystyrene into the hollow areas.This will add strength and stiffen the skins. The added strength is usually so remarkable that many structural members inside the skin can be eliminated and this decreases the mass of the wing.

Constructing a foam core structure is similar to building a built-up structure. Start by creating a skeleton framework around the fin and cut a piece of foam to fit any hollow area. Shape the foam using a sanding block so it exactly matches the perimeter defined by the skeletal framework. Bond the skin directly to the foam and any structural members. Epoxy is usually a safe adhesive to use on foam, while polyester resins and instant glues may melt it. Again, the type of skin should be appropriate for the expected loads and the shape of the fin. Flat and stiff skins such as light cardboard, thin balsa, thin plastic, or thin plywood are suitable only to fins with flat surfaces. For curved surfaces, fiberglass cloth soaked in epoxy is generally better. Several layers of fiberglass can be added to give extra strength to the fin. This technique is especially applicable to larger and higher-powered rockets.

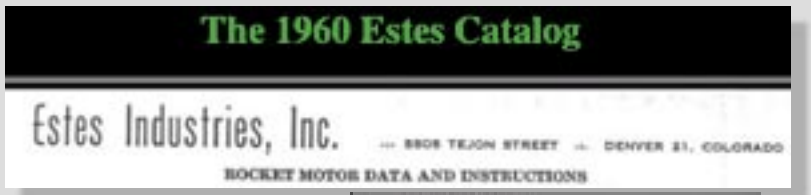


Foam core fins are good candidates for high power rockets

Foam Core Graphic from Model Rocket Design and Construction www.apogeerockets.com

Web Sites Worth Visiting

There are many of you who I'm sure know about our website worth visiting. I found this site a long time ago when I was first getting back into the hobby. I was searching for some information on my first model rocket from when I was in junior high school, which was an Estes Patriot rocket, as seen in **Picture 1**. I really thought it was huge way back when!


The 1960 Estes Catalog

Estes Industries, Inc. — 8808 TEJON STREET — DENVER 21, COLORADO

ROCKET MOTOR DATA AND INSTRUCTIONS

Picture 1

Picture 2

Follow the link http://www.ninfinger.org/~sven/rockets/rockets.html to Sven Knudson's website and you will be transported back in time to see a lot of your favorite rockets too. Sven has just about every catalog page posted from companies such as Centuri, Estes, Vashon, Enerjet, FSI, LOC, North Coast Rocketry, and many more! As you can see in **Picture 2**, the cover of the 1960 Estes 3-page catalog was pretty plain!

There are links to clubs and personal rocketeer webpages as well as some interesting links to White Sands and Robert Goddard Museums. I thoroughly enjoyed taking a trip down memory lane to see a lot of my favorite models over the past 30 years or so. I'm sure that you will, too. By the way, thanks for the link to our website Sven!

Question & Answer

Ryan writes to us in regards to the Perfectflite Altimeter (http://www.apogeerockets.com/Altimeter.asp) and asks, "With the USB data transfer kit, how many flights can be recorded? The website reads one at a time, so is it possible to save the recorded data to a memory stick or does it need a computer? More specifically, I have a little USB transfer device which allows me to copy data from one USB device to another without the computer as long as the USB devices have a FAT12, FAT16 or FAT32 file system. With this device I can copy stuff from my camera to a memory stick. Would the altimeter be able to be used with a device like this?"

The answer comes to us via the people at Perfectflite themselves. They say, "You do need a computer. Unlike a camera, memory card, etc. the altimeter does not function as a simple data storage device. It contains its own protocol for transferring flight data (among other functions) so it will only communicate with our software running on a host computer. It will not interface with a device that copies the contents of one USB storage device to another."