ISSUE 35

APOGEE

PEAK OF FLIGHT

NEWSLETTER

Speeding Up Your RockSim Simulations

By Tim Van Milligan

In the short history of RockSim v5.0, I've heard a lot of people say that this version is much slower than v4.0.

The reason it seems slower is RockSim v5 is actually calculating a lot more parameters during the launch. You can see all the different parameters (and compare them to version 4), by going to the plot menu.

The speed is further reduced because version 5 now also calculates the descent of the rocket after the recovery device is deployed. Since the descent is nearly always longer than the ascent, it takes more time to calculate the entire flight of the rocket.

Because of all these parameters, the speed of the simulations is reduced. But the benefit is that you have more data to examine, which makes RockSim v5 even more powerful.

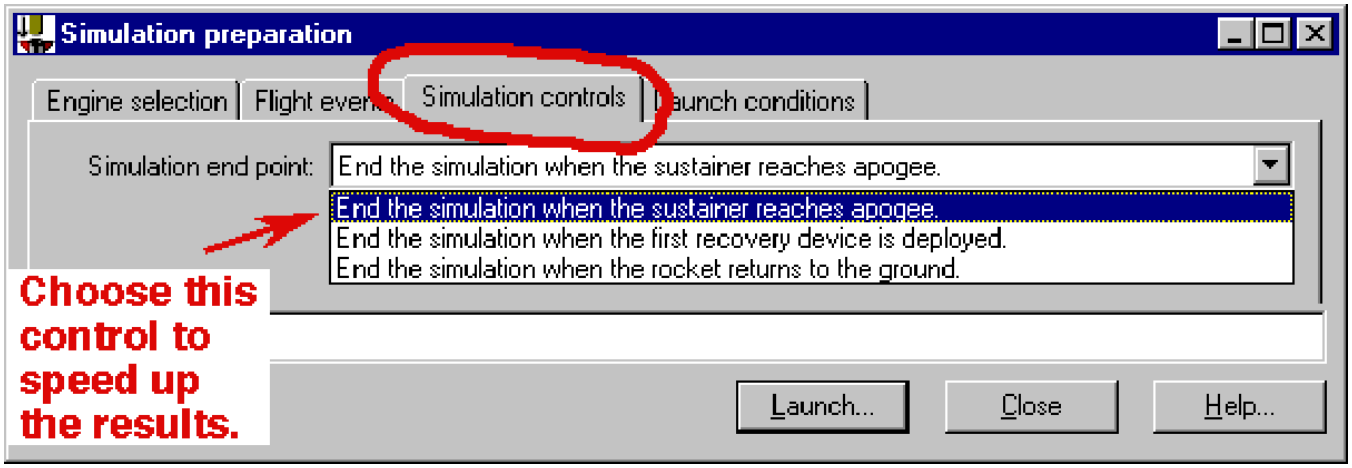
Besides going out and buying a new, faster computer, what can you do to increase the speed of the simulations?

Here are the things that I recommend:

Not every simulation you perform needs to be maximum accuracy. You can make some subtle changes that reduce accuracy slightly to increase simulation speed significantly. If you then need maximum accuracy, you can switch back to the prior defaults.

First: When going to load a motor, click on the "Simulation Controls" tab. Select "End the simulation when the rocket reaches apogee." This turns off the descent calculations (after the recovery device is deployed) This makes RockSim v5 run just like the old version 4. This will dramatically speed up the calculations for the entire flight.

Second: If you click on the Application Settings button, you can increase the speed by changing the "simulation resolution" under the "Simulation" tab. The default of RockSim v5 is 1000 samples per second. What this means is that RockSim is calculating each of the parameters 1000 times during each second the rocket is traveling upward. Since there are 60 parameters, there are a minimum of 60,000 calculations performed for each second prior to the recovery device being deployed. On a long burn motor (like the Apogee F10 with an 8 second burn time), RockSim must do at least 480,000 calculations. And some parameters require other calculations, so the number of mathematical calculations actually performed



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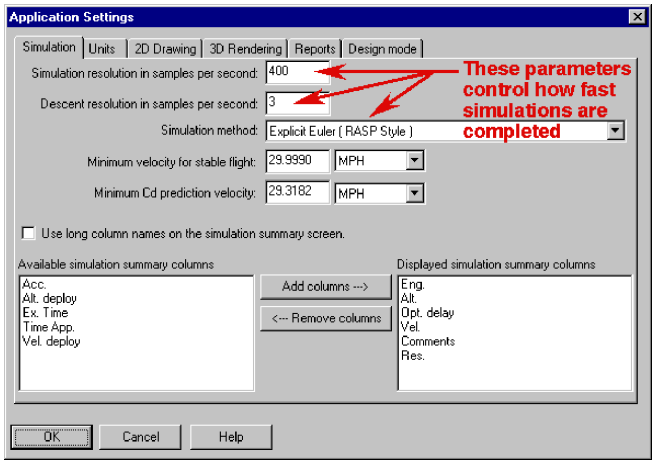

In the application settings, turn down the sample rate. This will greatly improve the speed of your simulations.

is incredible. All these make RockSim a powerful simulation program, but they also slow down the simulations.

Take a look at the size of the Temp files RockSim creates for each simulation. Some of them can be huge: 40 or more megabytes. That is a huge amount of data, and gives you an indication of what RockSim is doing during the time it is "thinking."

The "samples per second" number can be reduced with only a little bit of loss in accuracy. For flights with no wind, you can turn it down to 100 samples per second. The lower limit to this number is the motor's burn time and shape of the thrust curve. You don't want to set the number lower than the time distance between points on the thrust curve (which you can view in EngEdit that comes bundled with RockSim). For example, if points on the thrust curve are very close together, such as 0.02 seconds apart, then a sample rate of 50 could possibly miss those points on the thrust curve.

This can become more critical with motors that have extremely short thrust durations and very abrupt changes in the shape of the curve (ie.; lots of spikes on the curve). In that case, turn "up" the number of samples per second.

If there is "wind" in the simulation, don't go below 300 samples per second. This time the reason is that the rocket oscillates during ascent, and if the resolution is too low, the software may not accurately calculate the orientation of the rocket during quick oscillations.

Three: The descent rate resolution can also be turned way down. During descent, the model will always fall at a constant speed; except for the very brief time period when the parachute just opens. If you don't care about the little bit of inaccuracy just after deployment, you can turn the number all the way down to 1 sample per each second. I personally keep mine at 5 samples per second.

Four: Also in Application Settings, select the Explicit-Euler method over the Fourth Order Runge-Kutta method. This is about four times faster at any sample resolution. And the loss in accuracy is probably going to be less than a couple of feet on a typical rocket flight. I hope to post an R&D report to the Apogee Educational Guide that explains the difference between these two methods later.

Where you will notice a significant time lag is during optimum mass calculations. Make sure to use the speedier methods listed above. But you should try to bracket the optimum mass as much as possible during the set-up.

Start by choosing a reasonable starting point. For example, if you are flying a 12 pound rocket, it doesn't make a lot of sense to start the simulation at an initial mass of 1 gram. Start it at something much higher, say 9 pounds. Choosing the stopping point is equally important; but is harder to predict up front. But in the previous example, it doesn't make sense to stop the simulation at 100 pounds.

Also, use a mass step size as big as possible. In the example listed here, try a 28 gram (1 oz) step size on a big rockets -- instead of 1 gram. After the first "quick" run through, you can perform a second optimum mass that has been further bracketed. Example, if the first run through says the optimum mass in near 15 pounds, you can start the second simulation at 14 pounds, and stop it at 16 pounds. You can further increase the accuracy by reducing the step size.

As stated before, because of the "samples per second" you can easily predict that the longer the flight, the longer it will take RockSim to calculate the simulation. So long burn motors and multi-stage rockets will take longer to complete the simulation calculations.

Other areas that seems slower are the plot screen and the 2-D flight profile. The reason they are slower is that RockSim must perform additional calculations to display the data. With so many data points generated per flight, RockSim has to de-

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cide which data points to display on the screen, and which ones to ignore. Displaying all the points would take much longer, and wouldn't add any additional value to the displays.

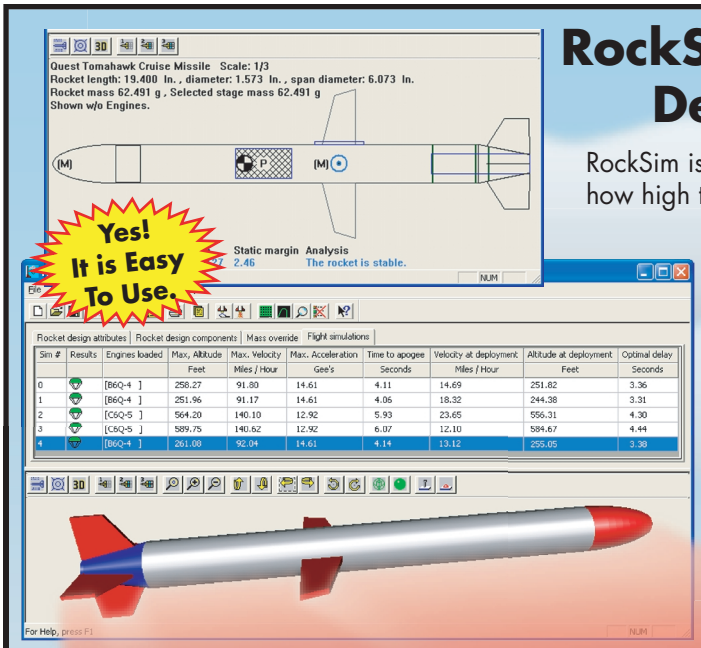
Also, because the sample rates are different -- before and after parachute deployment -- RockSim also has to make some interpolations after the deployment point to fill in some of the missing data for display on the screen.

To try to explain this, the lines you see on the plot (and the flight profile) are data points that are very close together. If it is displaying 100 data points/sec prior to deployment, then it also has to display 100 data points/sec after deployment. In the Flight Profile, if the numbers aren't the same, the rocket will "appear" like it falls significantly faster than it flies upward. So to continue the example, if the sample rate after deployment is only 10 calculation/second, then RockSim has to determine 90 other points during that time period.

In conclusion, RockSim v5 does take a little longer to perform simulations than v4. But the reason is that it is performing significantly more calculations to try to give you more data to make informed decisions about your launch. This makes v5 much better.

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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