Contents

1 Downloading

1. Go to `http://openrocket.info/`
2. Download v15.03 of OpenRocket
3. Select "Keep" if your computer says the file may be harmful
4. Download and install Java from `https://www.java.com/en/download/`
5. In your downloads, open OpenRocket (should work with Java installed)

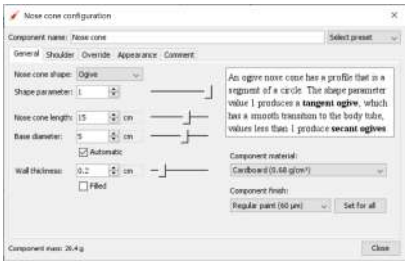
2 Basic Modeling

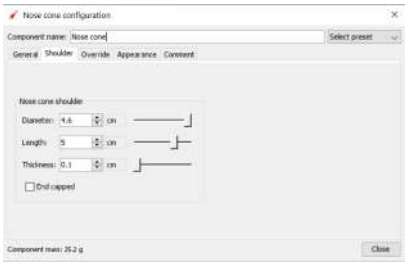
This panel includes the different sections of the rocket. On the left is the default configuration with OpenRocket. On the right is the panel with various components.

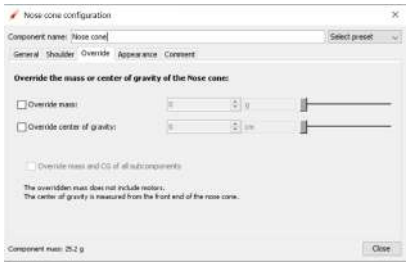
The nose cone and body tube will make up the main frame of the rocket. Let's start by inserting each of these components.

2.1 Nose Cone

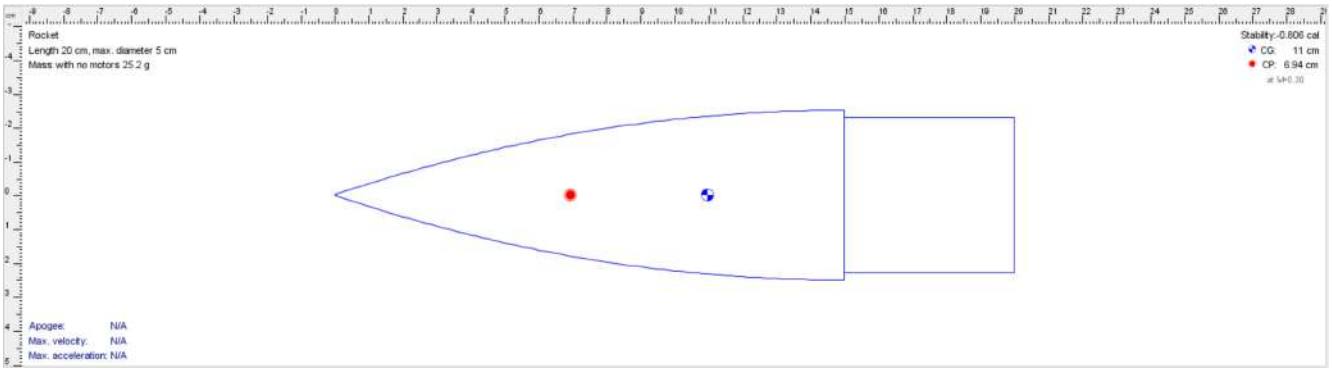
Click on the nose cone button and take a look at the first 3 tabs on the Nose Cone menu. Under the first tab, we have a variety of options of the nose cone shape, length, and wall thickness. Keep these parameters in mind when you buy your own parts. Next, take a look at the shoulder options. This is the portion of the nose cone that will slot into the body tube to keep the two together. Lastly, there is a tab to override parameters. This can be especially useful because it's unlikelt that OpenRocket will be able to precisely model the mass/CG of your parts, so you can input manufacturer data (or take your own measurements) here.





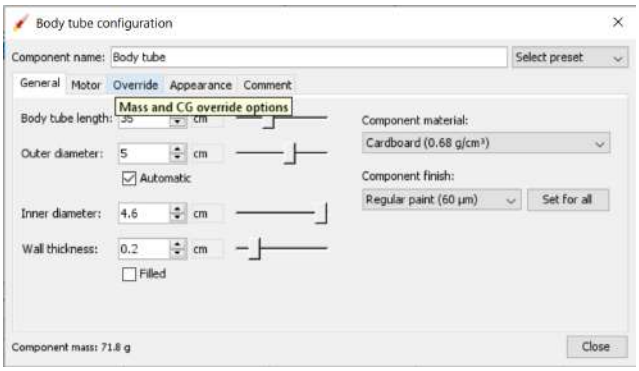


After inserting our nose cone, a schematic of the rocket will begin to form at the bottom of the screen. It also labels several important points on the rocket – most notably the Center of Pressure and the Center of Gravity. In order for a rocket to be considered stable, the CP must be below the CG.



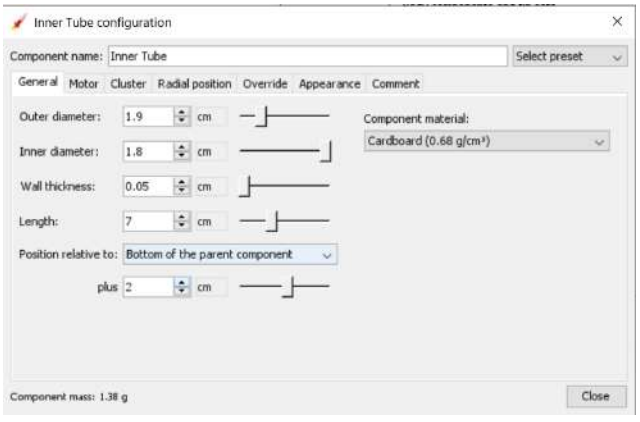
2.2 Body Tube

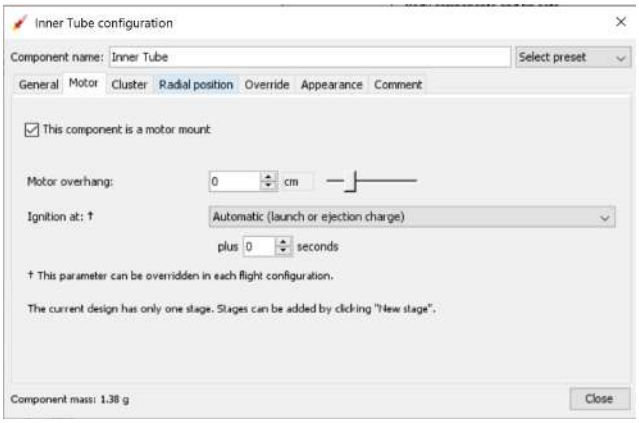
When we hit the body tube button, we get a menu very similar to the nose cone, but now with a motor tab, instead of a shoulder tab. Don't worry about the motor options yet, we'll get to them soon. Note: the inner diameter of your body tube should match the diameter of the shoulder from your nose cone, otherwise they won't fit together.



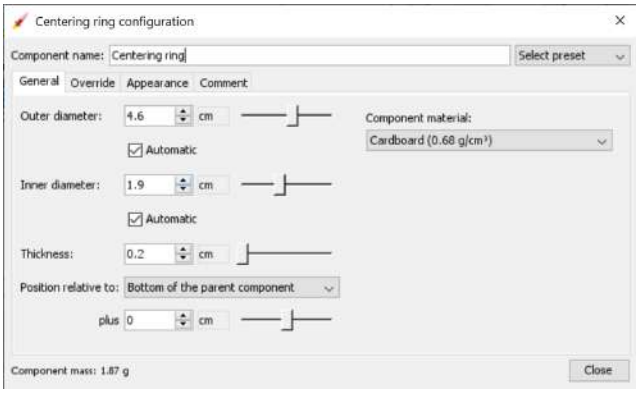
2.3 Motor Mount

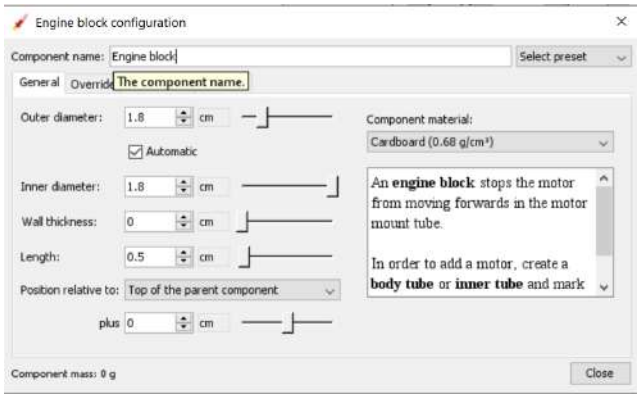
We insert our motor tube using the "Inner Tube" component. First, we want to add some offset to the tube, so that some of it sticks out the bottom. Do this using the offset function – we will be offsetting from the bottom of the parent, however you can use other points as a reference too. The next thing we want to do is specify that this is a motor mount. The remaining tabs aren't as important for our basic example.



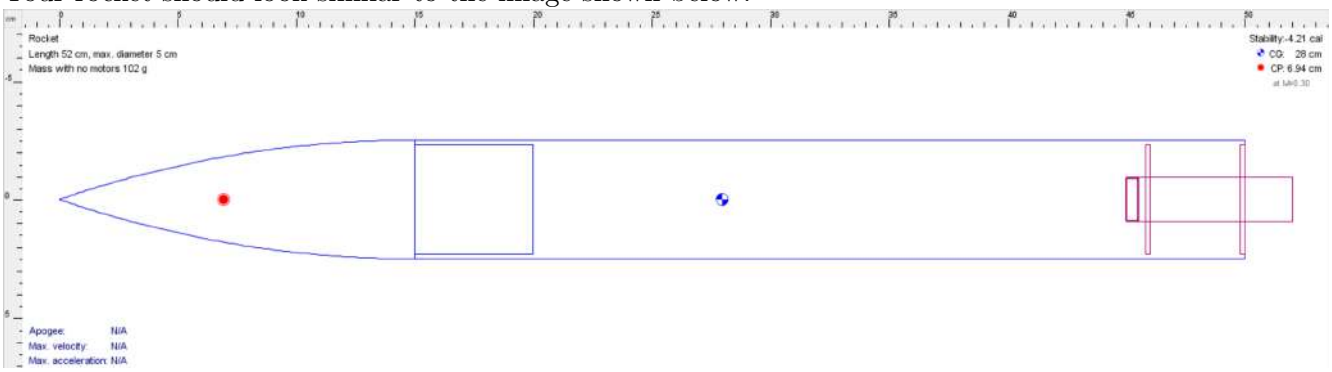


Next, we're going to add 2 centering rings to hold this inner tube in place. Make sure you have the body tube selected on your "sections" menu before adding them. Now, with the Inner Tube as the parent, add an engine block.



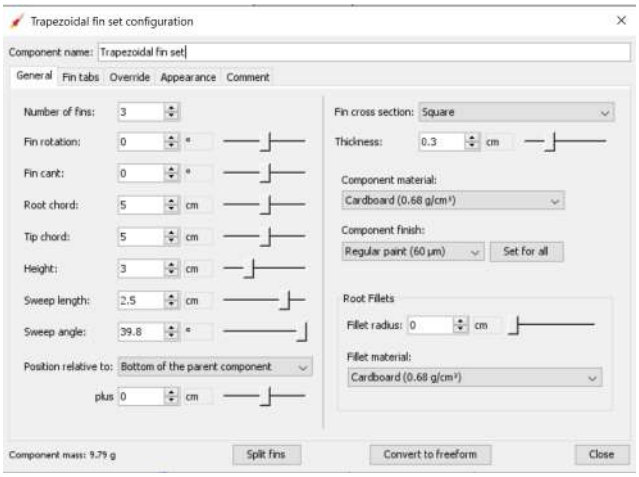


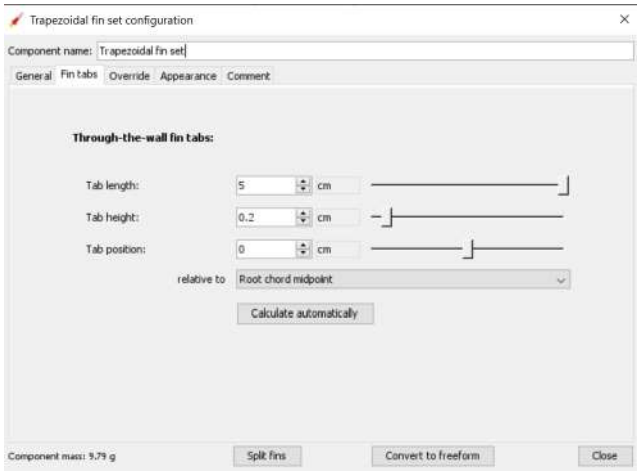
Your rocket should look similar to the image shown below:



2.4 Fins

There are lots of options for fins, but generally trapezoidal ones are some of the most common. By selecting the body tube, we can add fins.





The first page of options has to do with the profile shape of the fins. The dimensions of a fin are given to the right. The second tab refers to the fin tabs. These are extensions from the root chord, and fit inside the rocket, giving the fins extra stability and generally making them better secured.

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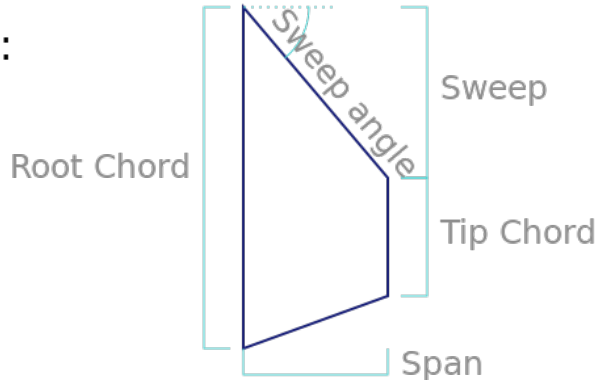
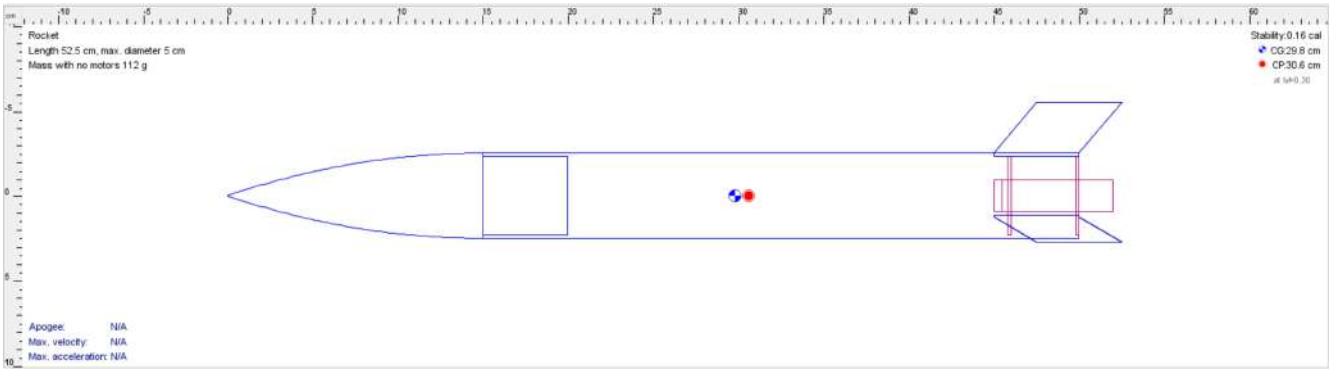
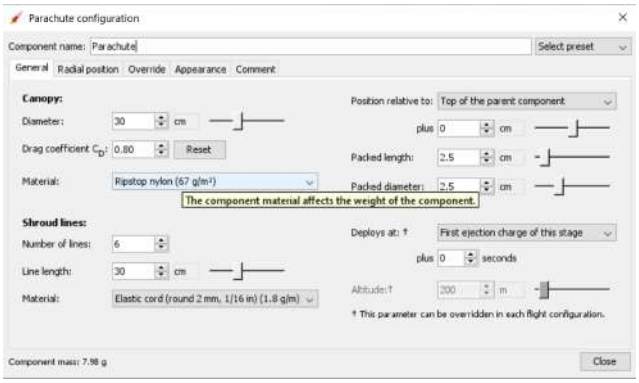


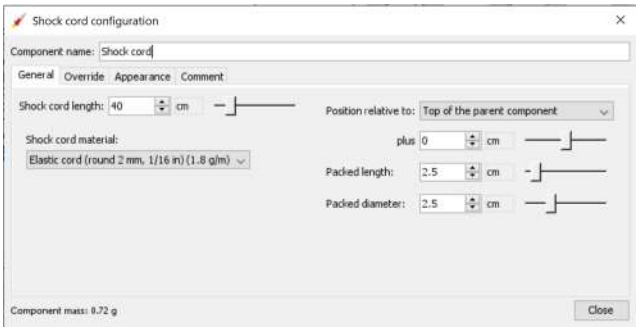
Lastly note how the fins radically alter the center of pressure:



2.5 Recovery

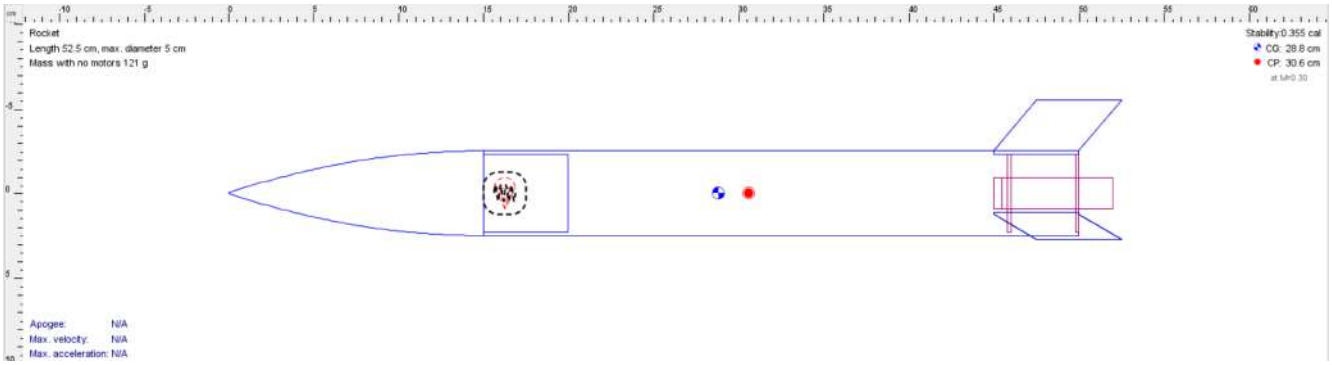
The last components we need to add are the recovery system. First we add in the parachute, and then the shock cord (used to keep the separated parts of the rocket together).





The configuration options for the shock cord are fairly simple, however the parachute comes with a multitude of options that get used during the simulation portion.

And with that, we have a rocket-looking thing! However, the real power of OpenRocket comes with its simulation tools discussed in the next section.


Rocket
Length 52.5 cm, max. diameter 5 cm
Mass with no motors 121 g
Stability: 0.355 cal
CG: 28.8 cm
CP: 30.6 cm
Apogee: N/A
Max. velocity: N/A
Max. acceleration: N/A

3 Basic Simulations

The simulations in OpenRocket are the useful part for us. It lets us know how high our rocket could go, how far it could drift, and its in-flight stability.

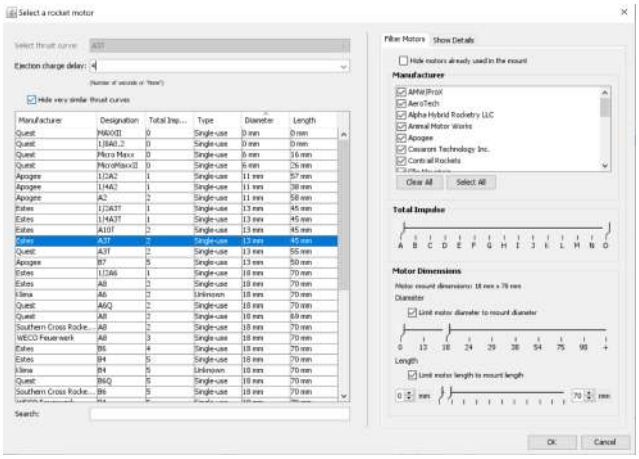
3.1 Motor Selection

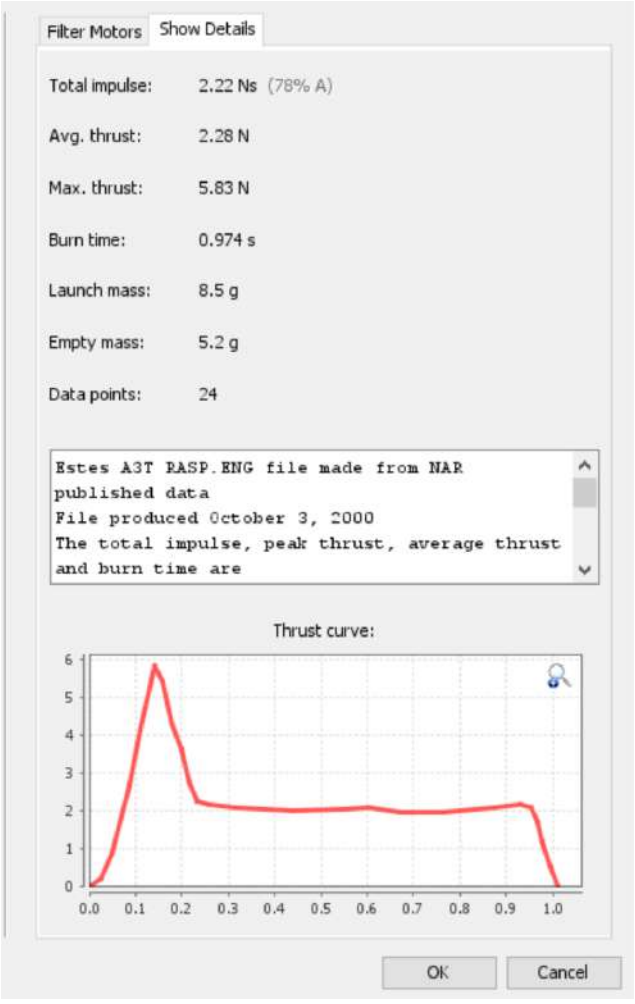
Switch tabs from the Rocket Design tab to the Motors & Configuration tab

Note that we can select different motor mounts (we did this earlier). Make sure the Inner Tube is selected. We can also make multiple configurations, where we simulate the rocket's characteristics using different motors. This makes picking between them a bit easier.

First, click on New Configuration and then Select Motor. Here, we can filter motors by a multitude of criteria, or you can search for a specific motor if you already have one in mind. For now, we'll constrain our searches to motors that fit inside the motor mount.

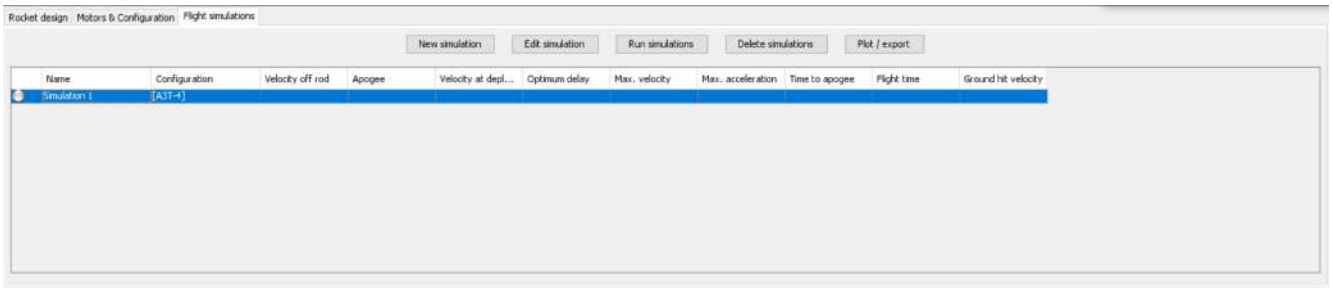
We can also look at the show details tab to get more detailed information about the specific motor in question.



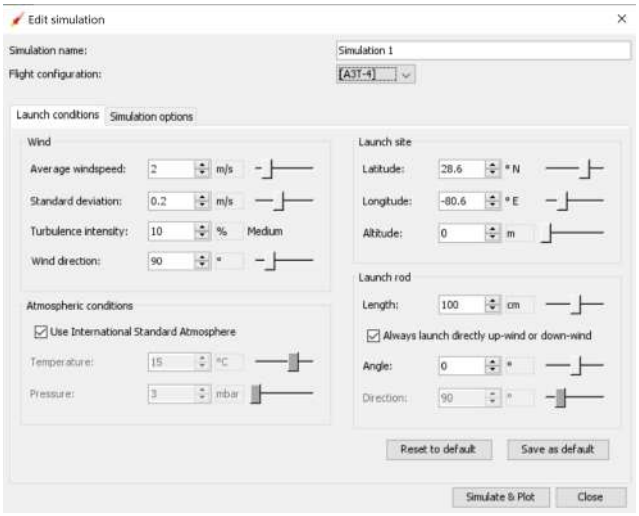


3.2 Simulations

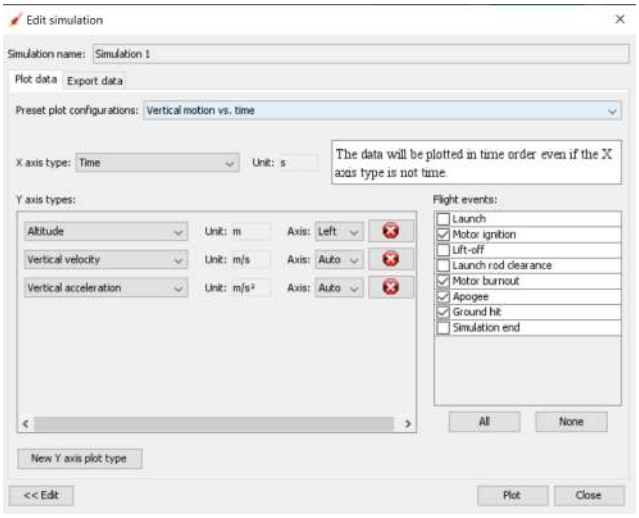
Now that we have a rocket design and a motor picked out, we can go to the Flight Simulations tab. For example, we might plan for a worst-case of $5\frac{m}{s}$ wind, or set the rocket to launch at an angle upwind.

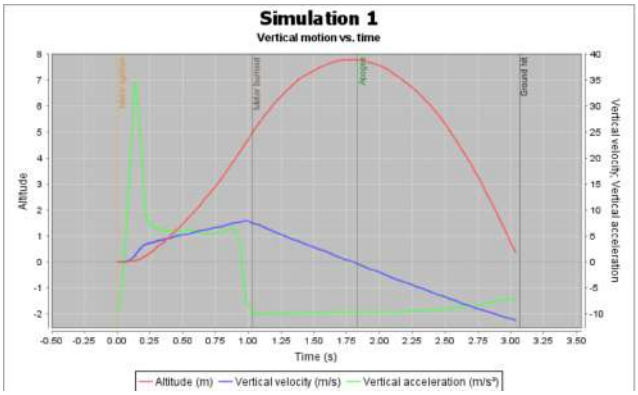


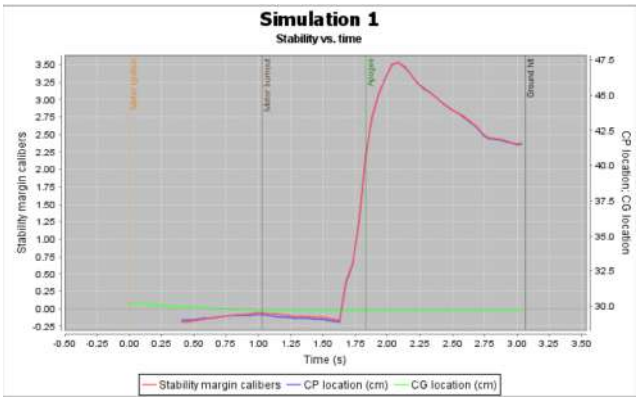
By default, there is already a simulation there, with some defined preset conditions. We can alter these as necessary.



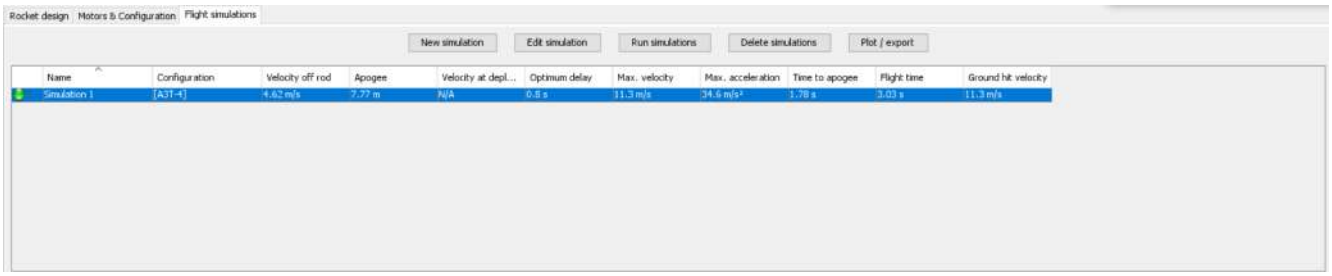
When we hit Simulate & Plot, we are brought to another menu, where we can specify exactly what we're interested in studying during this simulation. Let's run a couple simulations, one for vertical motion and another for stability.



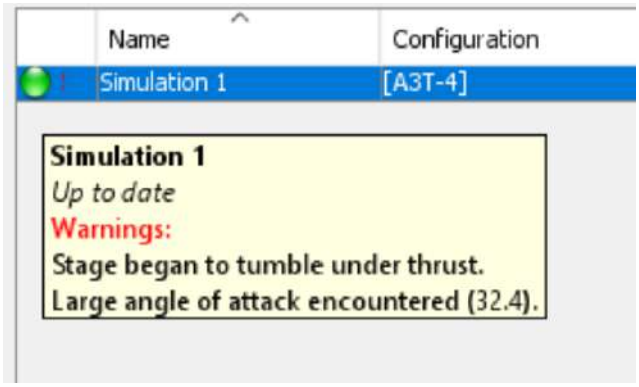




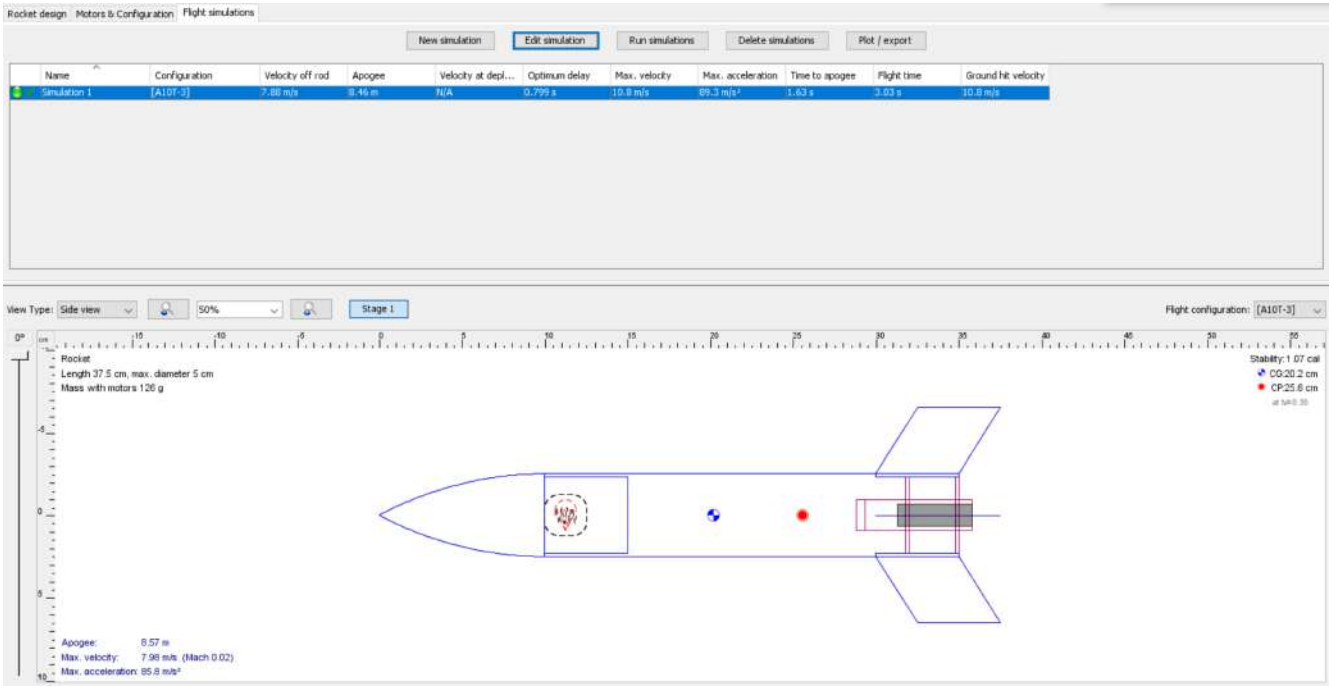
As you can see, we get a lot of important information from these simulations. We can understand how our acceleration, altitude, and stability vary with time. After you plot your results, the table on the main simulation page will also fill out.



Simulations can also give you warnings, if it detects something goes wrong. This is why simulations are so important – they allow us to spot possible design faults before it blows up.



After making some design tweaks, we can run our simulation again, this time with no warnings! If you have warnings, try seeing if you can understand what might cause bad behavior from your rocket, utilize Google, or stop by CMRC Office Hours for help.



A References

For additional help with OpenRocket, or guides to more advanced rockets, see:
`http://wiki.openrocket.info/Main_Page`

Images of fins from
`https://open-aerospace.github.io/barrowman/barrowman.html`