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How To Create Polyhedral Wings In RockSim v9 Using Pods



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How To Create Polyhedral Wings In RockSim v9

By Tim Van Milligan

RockSim 9 has been out since last Christmas and I haven't talked a lot about it yet. Nearly all of the RockSim articles I've written in this newsletter since then have been generic and applied to earlier versions of the software as well as to the latest. But in this article, I'll show you the new "pod" feature in Version 9.0, and how to use it to create polyhedral wings (or fins) for your rocket.

What is a Pod?

In RockSim version 9, a "Pod" is a collection of parts that are attached to the outside of the rocket. It is similar to the "Sub-Assembly" part that was available in previous versions of RockSim. The difference is that the Sub-Assembly had to be in-line or within the central core tube of the rocket. The pod is on the OUTSIDE. Because of this new pod feature, version 9 allows you to create some very unconventional looking rockets. Polyhedral wings/fins is just one example.

What is a Polyhedral Wing?

"Dihedral" is the upward angle from horizontal of the wings of an airplane. The purpose is to provide roll-stability to the airplane when flying straight and level. Without dihedral, the airplane doesn't want to stay level. It could just as easily fly upside down as it could fly right-side up.

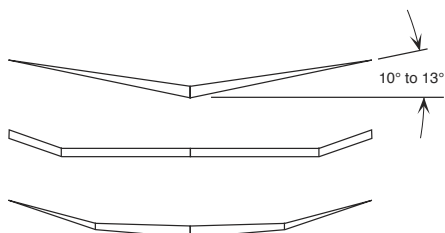


Fig. 1: Top to bottom: dihedral, tip-dihedral and polyhedral (from Model Rocket Design and Construction, page 206.)

Polyhedral is a special form of wing dihedral. Instead of the wing being made from one single panel, it is broken up into segments. This is more effective than simple dihedral, and it looks cooler too.

How Do You Make A Polyhedral Wing in RockSim v9?

To make a polyhedral wing requires the use of pods. The basic process of creating a pod is very similar to that of



Fig. 2: The "Pod" is a new component in version 9.

creating sub-assemblies. Here is the overview:

1. Select a part in the design where you'll attach the pod. Then click on the "Pod" button in "Add New Components" palette. (Figure 2)
2. Give the new pod a name and close the pod editor screen.
3. Add other parts to the pod.
4. After all the other parts have been added, come back and edit the pod. In this final step, you'll tweak the position of the parts.

Let's walk through the process by creating a simple design that uses polyhedral wings. Later, I'll show you how to attach the polyhedral wings to different locations on the body of the rocket.



Fig. 3: Start with a simple two-fin design

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Create Polyhedral Wings in RockSim

As shown in Figure 3, we'll start with a very basic rocket with a set of wings attached. I'm sure you can get this far on your own, as it is a simple rocket with the number of fins in the group set to just two. They are then rotated around the tube 90 degrees using the radial position tab in the fin editor screen.

Now we're going to add a pod. Before we do, we have to select the object in the parts tree where it is going to be attached. It can be attached to any of the parts actually, but it makes intuitive sense for someone else that may be looking at your design to attach it to the fin set. So we'll highlight the fin in the parts tree, and then click the pod button to add the new component.

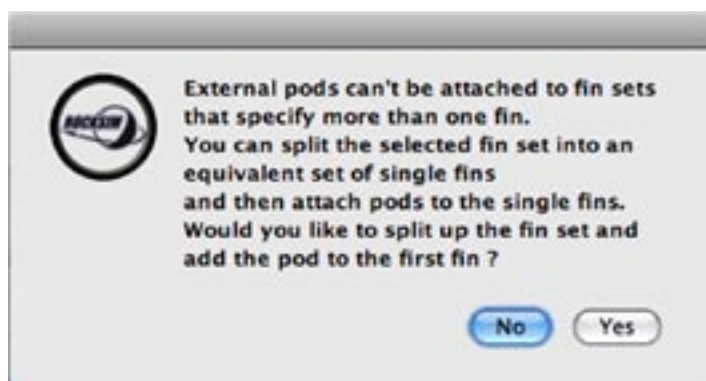


Fig. 4: This warning message will actually save you time, because RockSim will do the work for you when you click "Yes."

When we do that, we're going to immediately get a warning message. The message says that a pod can only be attached to one fin at a time. If you have a fin set with multiple fins, the set has to be broken up into individual fins. So you'll simply click on the "yes" button, and RockSim will automatically split the set up into multiple fins.

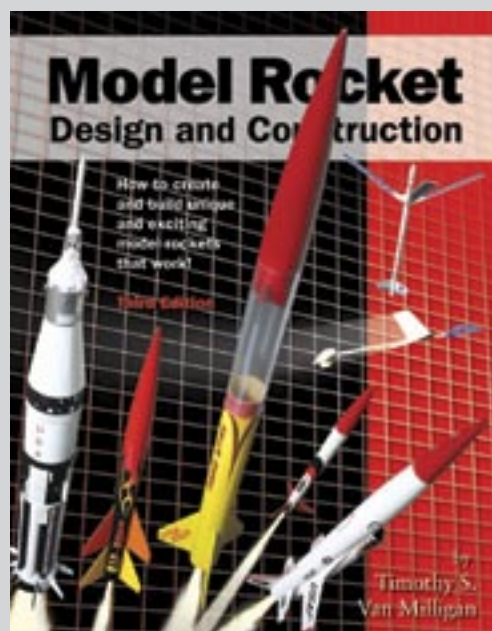
If you look at the parts tree at this point, you'll see that now you have two fin sets. One of the sets has a pod attached to it.

It should be noted that you could have done this manually yourself by creating each fin separately. And in the future, you probably will. Why? Because as we'll see later on, it will save you time by reducing the number of steps necessary to create the wings. Actually, you'll see that we only need one fin, because we'll duplicate it after we've attached the pod to it. But I'm getting ahead of the process, so let's back up a second.

After you select the YES button to allow RockSim to convert the set of fins into individual ones, you will immediately be taken to the pod editor screen. Right now, we don't need to do anything, except maybe to change the name of the pod. I like to give everything distinctive names so that I can tell them apart. And you'll want to too, because your rockets are going to get really complex, and it will get burdensome to edit them later if all your eighty pods in the design are simply called "pod." Because of that, I'm going to call this pod the "outer panel attachment pod."

With the pod attached, now we can start attaching

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By Timothy S. Van Milligan

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Create Polyhedral Wings in RockSim

parts to the pod. I'm only going to attach a single fin to the pod, I'll make sure the pod is highlighted in the parts tree, and then simply add a trapezoid fin to it.

Now a fin editor screen will come up. Since I only want to add one single fin, I'll go ahead and change the number of fins from three to one.

When adding this fin, you may notice a couple of

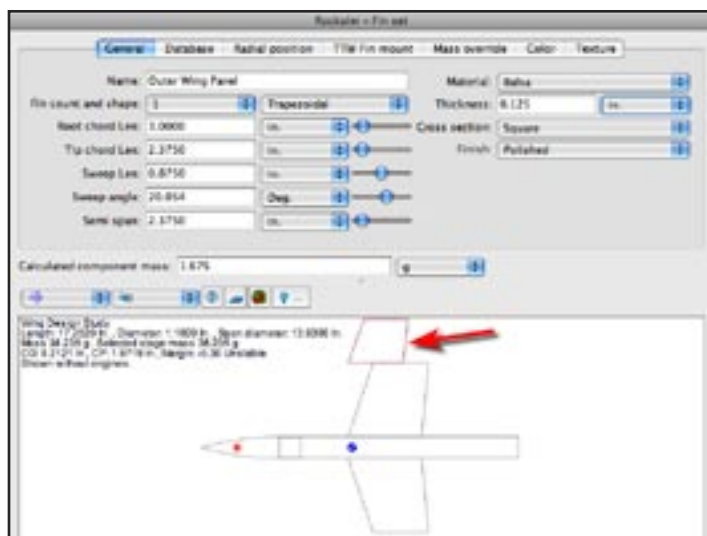


Fig. 5: Add a fin extension to the pod that is on the tip of the inner wing panel.

things. First, it may have to be rotated 90 degrees in the "radial position" tab so you can see it. I rotated the inner wing panel 90°, so in this design I also have to rotate the outer wing panel by the same amount. We'll come back to the radial position tab later, because we want it at a different angle other than 90°.

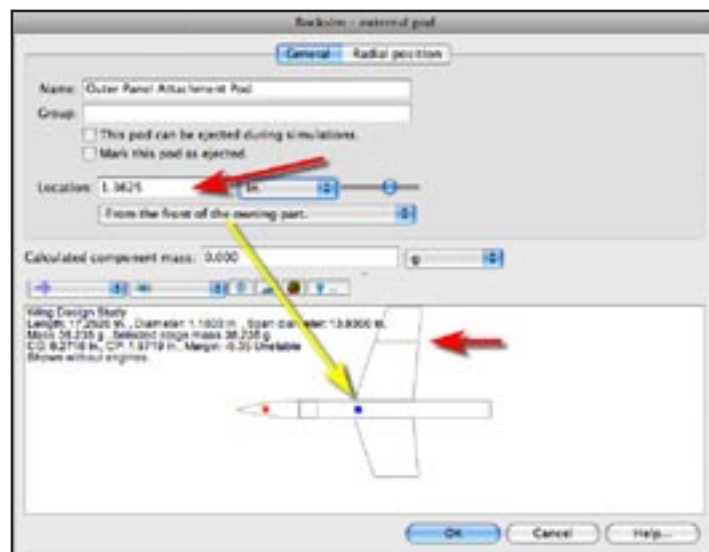


Fig. 6: In the pod editor, you'll move the fin extension back to the right location. Note that the 'front of the owning part' is where the fin is attached to the tube.

Continued on page 5

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Create Polyhedral Wings in RockSim

As you enter the size dimensions to the new outer wing panel, you'll notice something else. There is no "position" slider on the screen like there would for a regular fin attached to a tube. This is because the fin is attached to the pod, and the "pod" controls the location of the parts. Do you get an idea what the next step will be? Right. We need to go back to the "Outer Panel Attachment Pod" and adjust the location (where it is attached to the fin).

When we go back to the pod editor screen, just use the

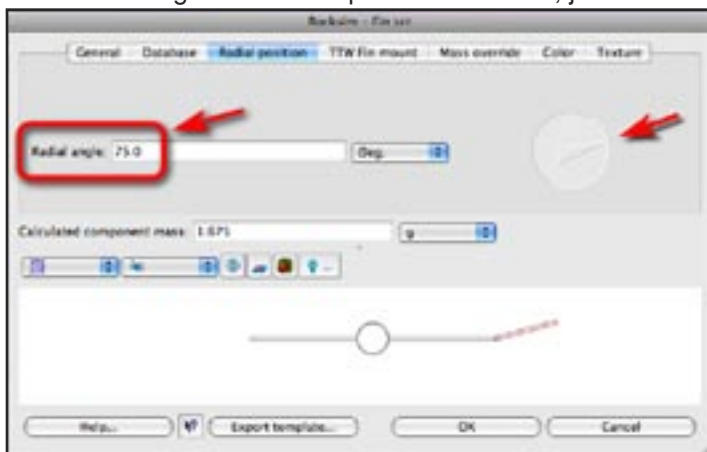


Fig. 7: One final adjustment is necessary in the fin editor screen to tilt the wing extension.

slider bar to move the fin where you want it to be (Figure 6). Finally, uncheck the little box that says "This pod can be ejected during simulations." Since this is a fin, we want to keep it attached throughout the entire flight. Now click OK to save the change to the pod.

Our outer wing panel is not a polyhedral yet. The only thing we need to do is adjust the radial position of it; in other words, we're going to tilt it upward with respect to the rocket body. We'll go back to the fin editor screen for the outer wing panel to do this (do you see now why everything needs to have a distinctive name?).

When we get to the fin editor screen, switch to the base view, so you can see the effect of changing the radial angle of fin (shown in Figure 7).

Once the radial adjustment is completed, you'll see we've got one wing completed as shown in Figure 8. Now all we have to do is the identical procedure to the other main wing.

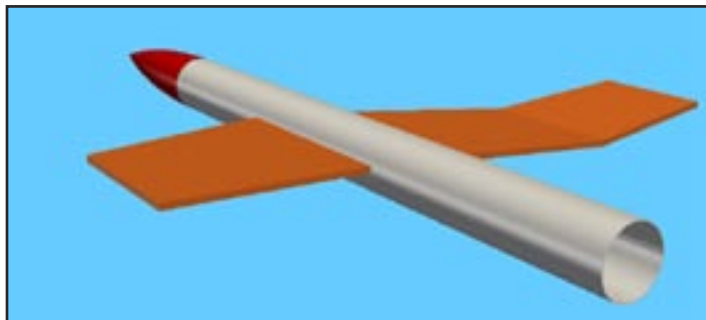


Fig. 8: The right wing is now completed.

But that would be silly because it is a lot of work. It would be easier if we just copied the existing wing, and flipped it over to the other side of the rocket. And that is exactly what we will do. Therefore the existing fin, which

Continued on page 6

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Create Polyhedral Wings in RockSim

doesn't have a pod on it, is going to be in the way. The solution is just to delete it from the rocket design. Remember earlier I said it would be simpler to just do a single fin? If we did just one earlier, we would have removed the step of deleting the unused one. I hope this makes sense to you, because if it does, you'll be making designs a lot faster in the future. Copy and Paste is a great time saver.

You just need to highlight "Fin Set-1", and choose Copy from the Edit menu. Then highlight the body tube, and choose Paste from the edit menu. You'll have two Fin Set-1's. At this point, they are superimposed on top of each other. So we have to move the new one so we can set it by itself. Double click on the new Fin Set-1 to open up the fin editor. Then click on the Radial Position tab. Using your keyboard, just put a negative sign in front of the 90 to make it a -90° as shown in Figure 9. That flips it over to the other side of the tube.

The only other thing we need to do in the fin editor is to change the name of the fin. It makes it too hard to edit the design when we have two parts called Fin Set-1. A descriptive name would be "Portside fin," but for the sake of speed, I'll just change it to Fin Set-2.

The tip of the fin is angled down at this point, because



Fig. 9: Once the wing is duplicated, use the radial position tab to rotate it to the other side of the rocket.

basically we flopped it over to the other side of the tube. We'll correct that next by editing the outer wing panel.

Open in the fin editor the outer wing panel that is connected to the pod of Fin Set-2. In the Radial Position Tab, adjust the angle so it matches the wing on the other side of the rocket. I find viewing the design in the base view works best here.

YEA! We've created a polyhedral wing! Figure 10 shows the 3D view of what you've accomplished.

Continued on page 7

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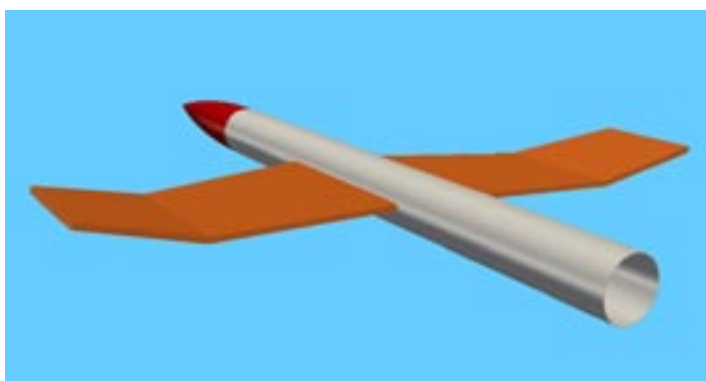


Fig. 10: With both tips tilted upward, you have the special case of polyhedral called “tip-dihedral.”

Offset To The Tube Polyhedral Wing

If you look at our design, the wings are polyhedral, but they are still protrude from the center of the tube. Wouldn't it be cool if they were attached to the top or the bottom of the tube? I think so too, so I'll show you how to do that next.

Here is the general procedure: we're going to take our existing design and move the wings to a new pod that is on top of the tube.

The obvious first step is to create a new pod on the rocket. This pod is going to be attached to the tube of the rocket. Highlight the body tube in the parts tree, and then click on the pod button to create the new component in the design. When the Pod Editor screen opens up, all we're going to do is give it a new name. In my design, I'm calling it the “Top Mounted Wing Starboard Pod.”

We're going to do the cut-and-paste procedure again here. Select one wing and choose “Cut” from the “Edit” menu. Then highlight the new pod and paste it to it. You'll end up with something that looks like Figure 11.

Wing Design Study
Length: 17.2520 In., Diameter: 1.1800 In., Span diameter: 13.9300 In.
Mass 39.911 g., Selected stage mass 39.911 g
CG: 7.8899 In., CP: 7.0118 In., Margin: -0.75 Unstable
Shown without engines.

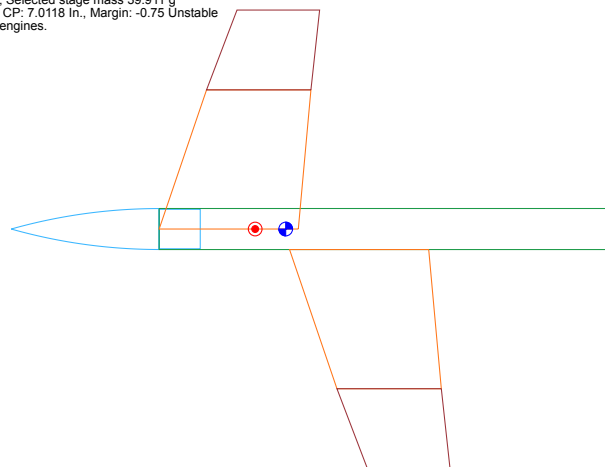


Fig. 11: The right wing was moved to a pod that is on the top and front of the body tube.

Now do the same thing with the other wing. Create a NEW pod, and Cut-and-Paste the other wing onto the pod. You must create a new pod for the part, as things get weird with the design if you don't.

The parts tree at this point is shown in Figure 12. Of course it is collapsed and all the fins aren't showing, But it looks pretty simple, doesn't it?

Now all we have to do is move the two pods back to the correct location on the rocket in the pod-editor screens. I'm sure that you can do this without me walking you through the steps.

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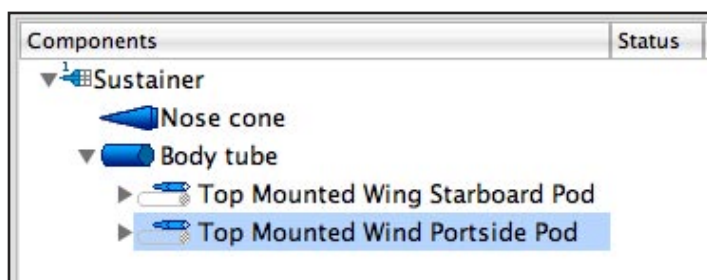


Fig 12: The wing is composed of two pods.

My rocket with the off-set tip-dihedral wings looks great, as shown in Figure 13.

There is one final tweak you might do. That is to go back to the inner wing panels and change their radial position. For example, I went back and tweaked them so they are tilted 10° from the horizontal line. As shown in Figure 14, the wing is a true polyhedral now, where before it was a form of polyhedral called tip-dihedral (Figures 10 and 13).

Gliders in RockSim?

RockSim is now pretty close to being a glider design program as well as being the best for creating rockets. Don't tell the glider folks yet. Let's keep it our secret.

Why? Because we're not totally there yet. The one piece of information is the Neutral Point of a glider. The



Fig 13: The wing is now off-set with respect to the centerline of the tube.

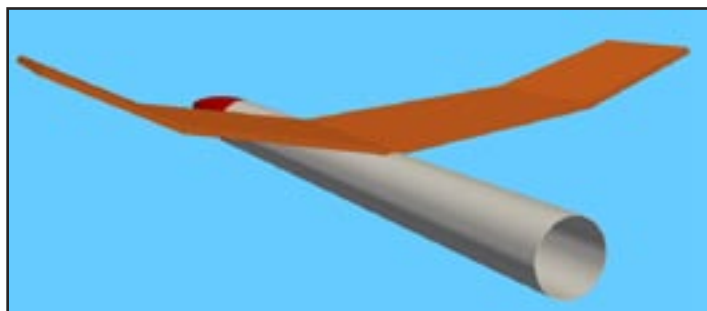


Fig 14: Finally, the radial position of the inner wing panels are each tilted 10°, making a true polyhedral wing.



Fig 15: Displaying the glide CP (Neutral Point) is coming in a future version of RockSim v9.

Neutral Point is the CP of the glider in one axis of the rocket. RockSim does calculate it, but it doesn't display it as such right now. The CP that RockSim displays is always the "worst case" CP location. For a flat wing glider (like shown in Figure 3, the CP will be somewhere on the nose cone. It can get very confusing for users if there are multiple CP's displayed.

We're still working on a way to display the Neutral Point CP without creating more confusion for people that are just getting started with RockSim. That is why it is displayed in the preferences of RockSim, although it is non-selectable at this point (Figure 15). It is "rocket science" after all.

Conclusion

This process looks complicated on paper, but when you give it a try, it actually isn't too hard. It is really fun, in that you are making something that is actually pretty complex.

About The Author:

Tim Van Milligan (a.k.a. "Mr. Rocket") is a real rocket scientist who likes helping out other rocketeers. 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 a 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 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 a FREE e-zine newsletter about model rockets. You can subscribe to the e-zine at the Apogee Components web site or by sending an e-mail to: ezine@apogeerockets.com with "SUBSCRIBE" as the subject line of the message.