Issue 654 / June 17th, 2025

PEAK OF FLIGHT NEWSLETTER

Apogee Components, Inc. / ApogeeRockets.com / Colorado Springs, CO

Mastering Offset Thrust in RockSim-Pro



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Killer Bee Rocket Plan

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by Tim Van Milligan

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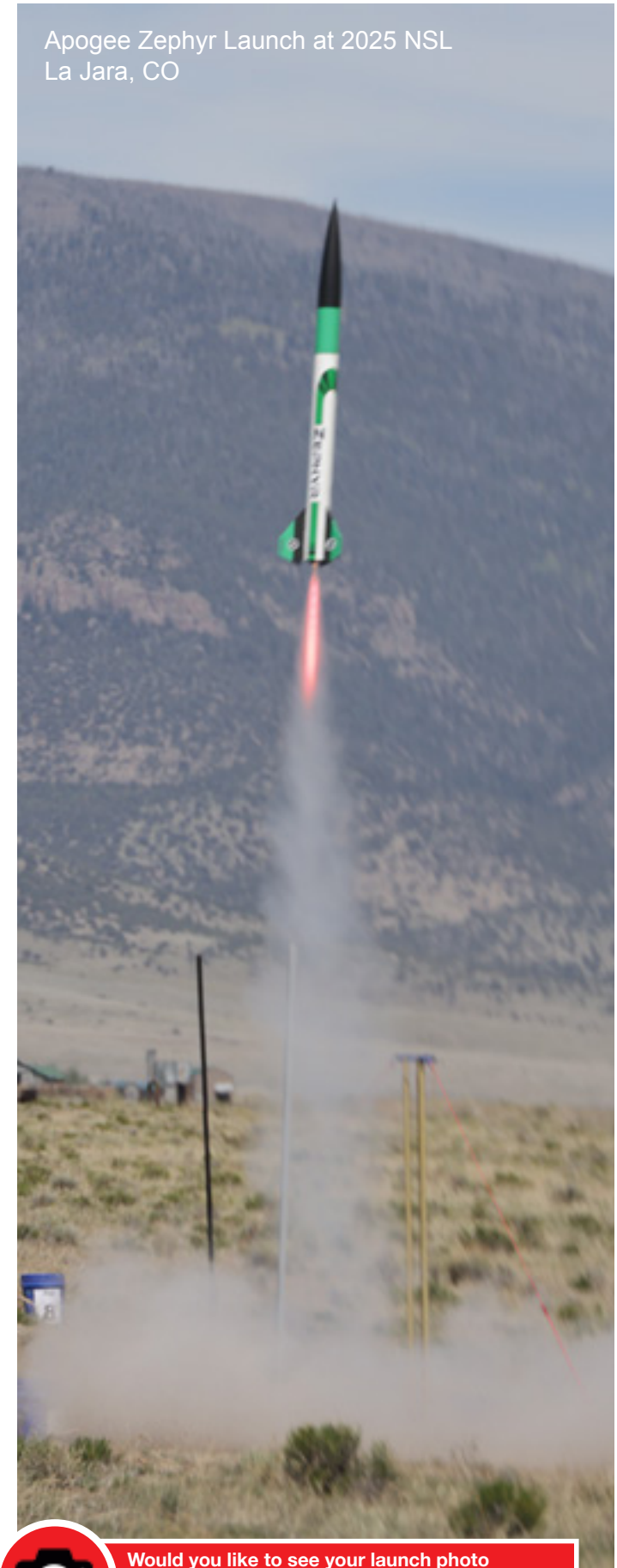
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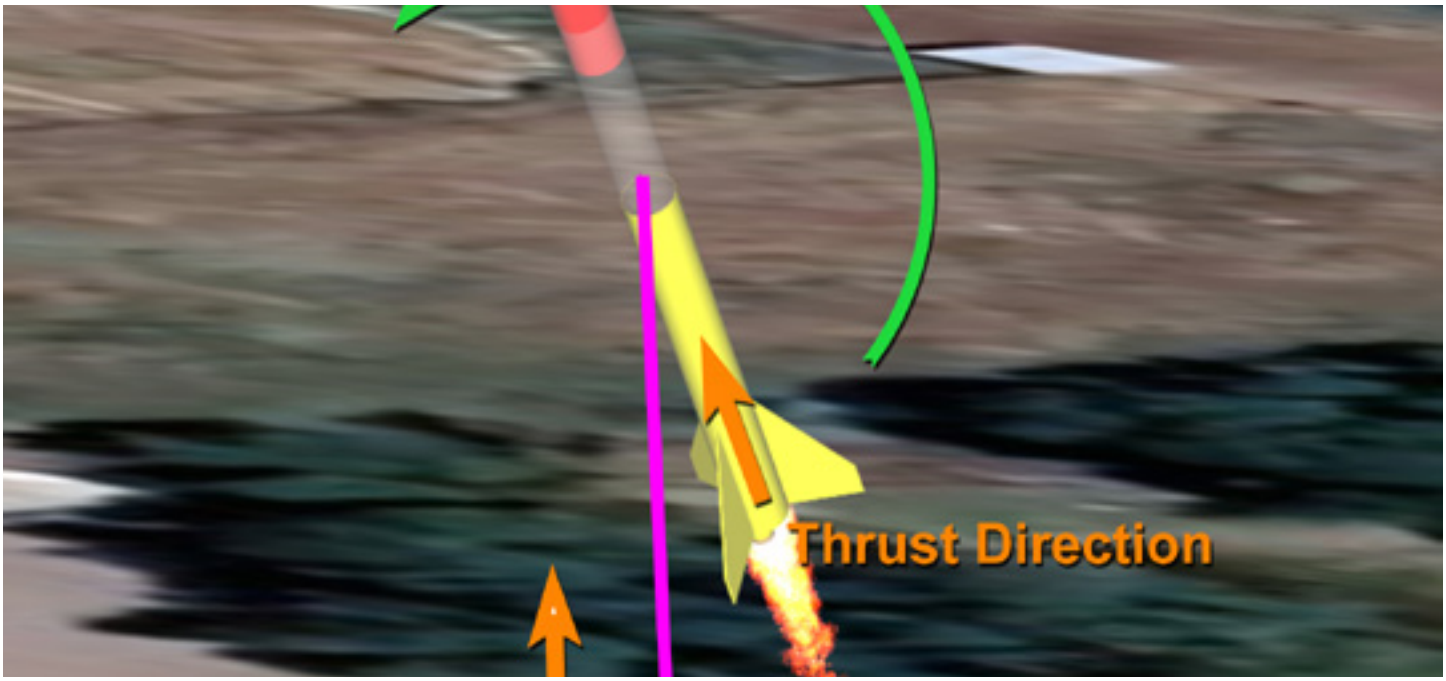
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Mastering Offset Thrust in RockSim-Pro

by Tim Van Milligan

Want to know a poorly kept secret? RockSim-Pro holds a powerful feature that most rocketeers never touch. It's called offset thrust—or motor canting—and it allows you to create and experiment with launch situations that would be far too dangerous to contemplate in real life. Think of it as the premiere test lab for thrust vectoring, where mistakes won't result in a shredded airframe or a wallet-draining motor. Let's go over how to harness this tool like a pro.

Introduction

Generally, we don't believe that canted motors are ever the cause of an unstable flight, mainly because commercially made centering rings are just so perfect that they always keep the rocket motor aligned with the center axis of the rocket. Even homemade centering rings are so close to being perfect that it's difficult to suspect that canted motors caused the rocket to go unstable. So why talk about canted motors? Because they allow rocketeers to experiment with unusual situations of rocket design—keeping the hobby interesting. Here at apogee, we are always trying to come up with new types of rockets, and if we dig deep and understand the physics of what is going on, we can eventually exploit odd situations to develop interesting types of rockets.



Figure 1: Canted engines on a cluster rocket.

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RockSim-Pro is unique in how it allows you to do things like canted motors and canted fins because it treats the flight in three dimensions instead of just two (which makes it even better than RockSim or Open Rocket). RockSim Pro has always had the ability to cant the rocket engines - even from the beginning in version 1.0, but people have rarely used it because they don't understand how it works.

The question we'll answer is: "How can I simulate and master canted thrust in RockSim-Pro?" Upon entering "non-zero" angles in the software's Axis Error fields, rocketeers will step into a realm that merges engineering, artistry, and a bit of puzzling software logic. The software's visual displays may not show canted nozzles, but the simulation engine will be calculating them. From our experience, we can testify that this somewhat hidden setting is truly a gem in RockSim-Pro, unlocking advanced flight dynamics normally left to guesswork or expensive test flights.

What Is Offset Thrust?

At its essence, offset thrust occurs when the motor's thrust vector does not align perfectly with the rocket's centerline.

There are two ways to create offset thrust. The first is to move the rocket motor off-center of the axis of the rocket body, as seen in Figure 2. This is easily accomplished during the design phase—simply adjust the radial position of the "inside tube" that is designated as the motor mount.

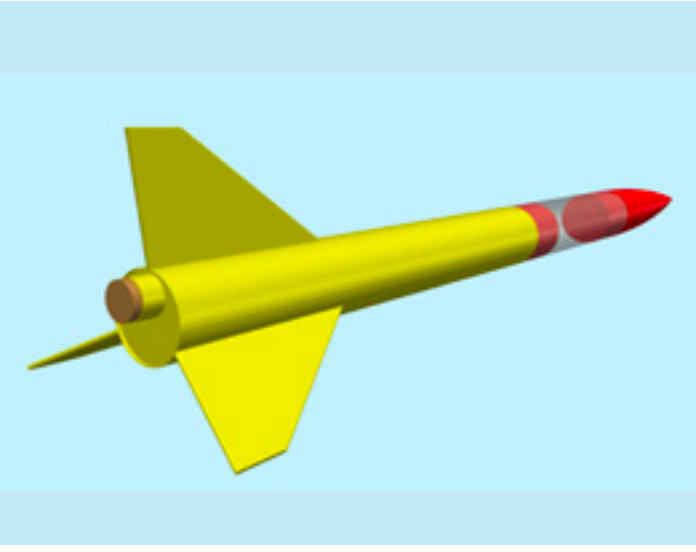


Figure 2 - Moving the rocket engine off the centerline will give you offset thrust.

Don't Cant a Lone Motor

Besides designing a boost glider, or aiming for a wild smoke plume, in a conventional single-engine rocket, deliberately canting the motor to do things like "fight against the wind" is dangerous. When skewing the nozzle even slightly off the central axis, it sets off a cascade of what is called "pitch--roll coupling." A canted nozzle will cause the rocket to pitch over to one side; which means that one fin will always produce extra lift, creating a rolling moment that leads the rocket into wild, erratic tumbling spins. These unpredictable motions are not the controlled adjustments for those looking to fight against the wind.

There are very limited exceptions for canting a single-engine model, which will be mentioned in this article. Regardless of the approach, safety must be paramount: always keep angles minimal, validate ideas in RockSim-Pro, and use intentional motor canting only in validated experimental designs or specialized configurations.

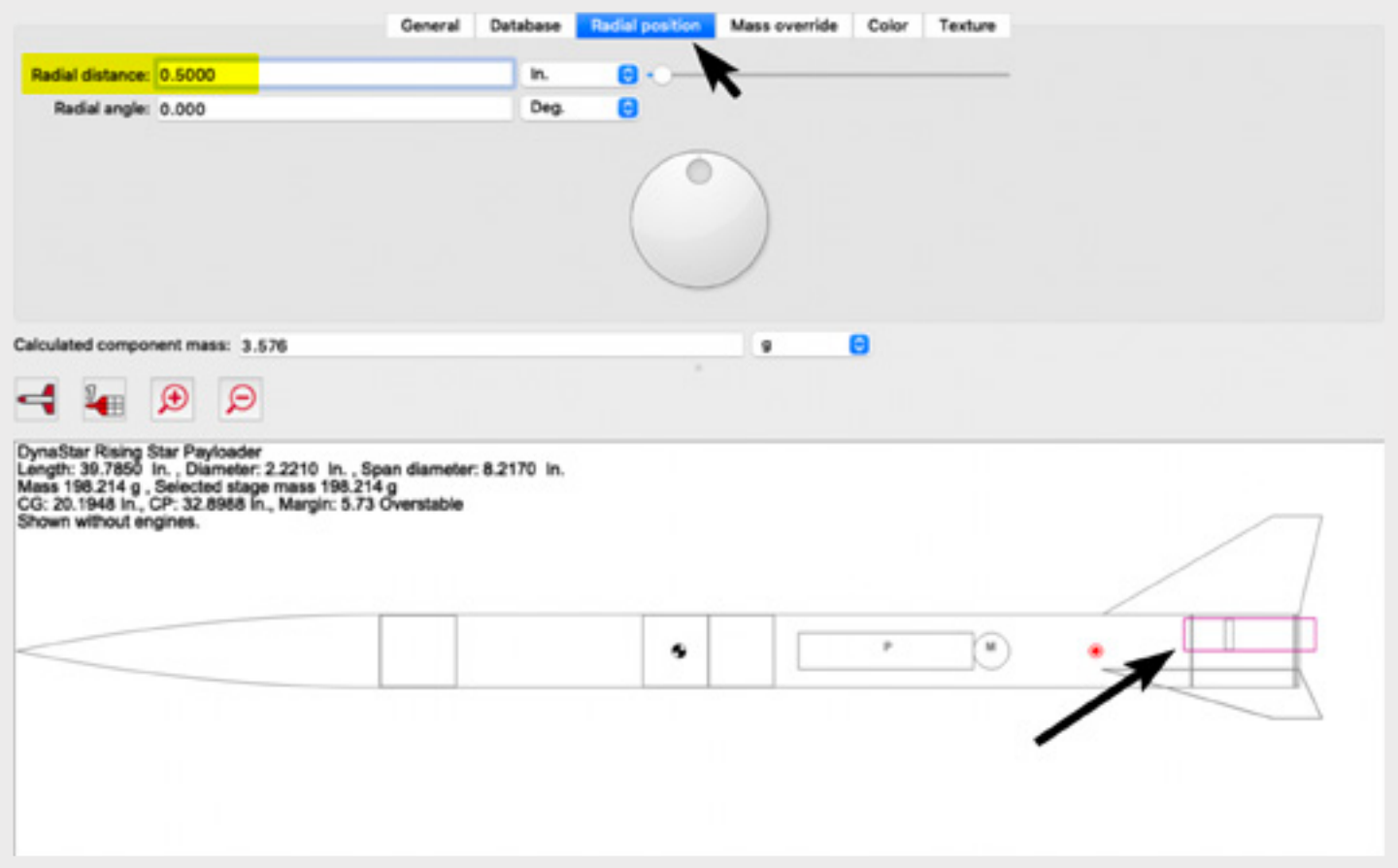


Figure 3 - Making an off-center motor is accomplished with the Radial Distance field of the motor mount tube.

The second way of creating offset thrust is to cant or tilt the motor mount tube. Instead of the force acting directly along the vehicle's longitudinal axis, a fraction of that force is applied off-center. Think of it in the same way you might imagine an outboard motor on a boat. If the motor is angled even slightly, the boat will veer in the opposite direction of the engine's tilt—not because the engine is "steering" the craft, but because the entire thrust vector has been displaced. In the fixed-motor world of model rocketry, this deliberate misalignment is a valuable means of simulating real flight disturbances.

How is this tilt accomplished? This is where the "trick" comes in. The motor itself must be designated to have the tilt rather than the motor tube. This can be designated when loading the rocket engine into the motor mount tube prior to running a simulation.



Figure 4 - A motor boat is steered by pivoting the motor to make vectored thrust.

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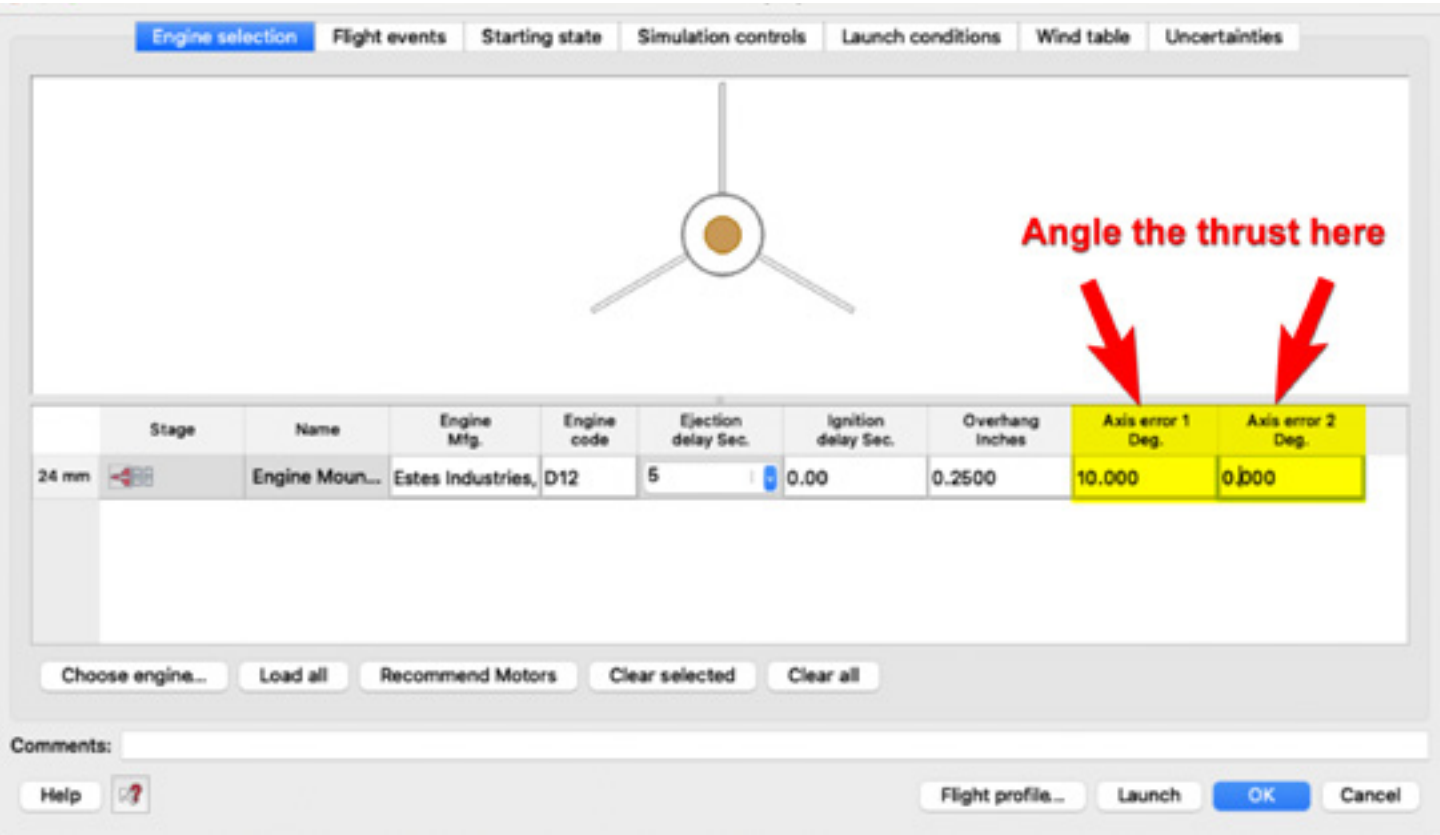


Figure 5: When you load the motor in RockSim-Pro, you can specify two thrust axis errors. This is how you tilt the motor.

Motor Control Parameters: Axis Error 1 & 2

There are two fields that typically go unused in RockSim Pro when loading rocket engines: Axis Error 1 and Axis Error 2, as shown in Figure 5. The numbers that go in these fields will allow for simulating how much the motor's thrust is shifted away from the centerline, and in what direction.







Figure 6 - Error Axis 1 tilts the motor in this CAD rendering.

Axis Error 1 (Cant Angle - see Figure 6) shows by how many degrees the thrust vector is off-center. A setting of 0° means perfect alignment. Adjusting this level upwards, even just a little, will introduce a lateral force component.

Axis Error 2 (Rotation Angle - see figure 7) functions like a compass, specifying the direction in which the thrust is canted. For example, with Axis Error 2 set to 0° and a cant of 5°, the motor's nozzle is effectively tilted such that the rocket will have a force component that causes it to drift in the direction opposite to that tilt. If the nozzle tilts "north," the rocket will arc toward the south. Changing the rotation angle alters the directional bias accordingly.

One thing to note is that, even when these values are inputted, RockSim-Pro's visual representations of the rocket remain unchanged. The motor is always drawn as if perfectly aligned.

Some historical precedent may assist in understanding what happens to the model rocket when changing the Axis Errors 1 & 2. The German V2 missile used small vanes in its exhaust stream to create a laterally deflected flow, effectively altering its line of thrust. The motor was straight along the axis of the rocket, just like in RockSim-Pro. But it still had the capability to adjust the thrust angle by means of the vanes in the flow of the exhaust. Think of Rocksim-Pro operating the same way—the motor is drawn straight, but the thrust direction can be changed.

Only through the flight simulation—such as the 3D Launch Visualizer—can we really see the impact of these adjustments. Seeing the flight visualized can help understand the effects of a canted rocket motor, even when the motor image appears straight.



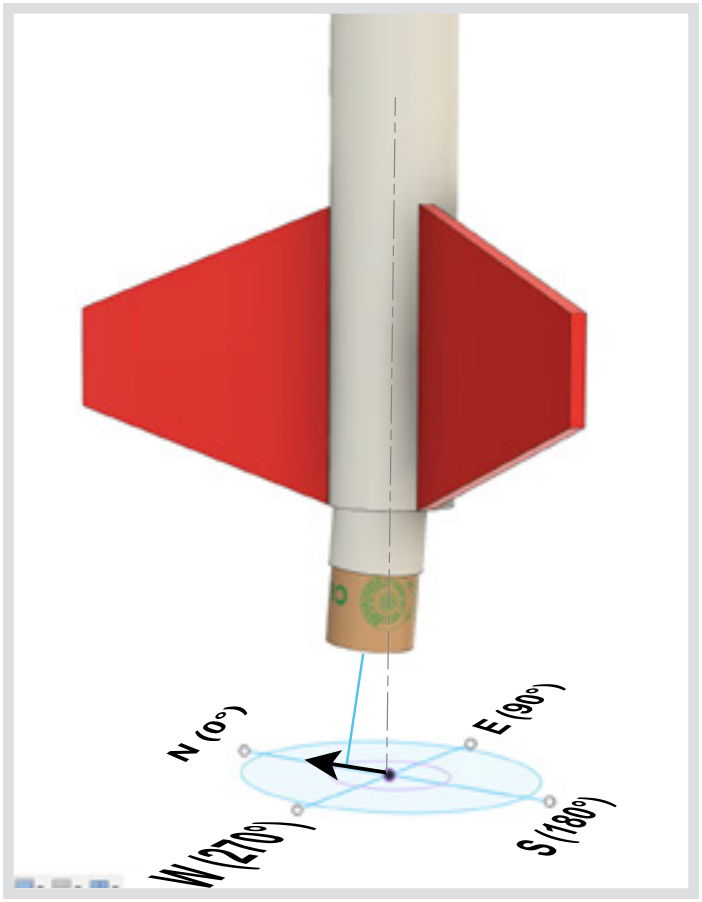


Figure 7 - Error axis 2 sets the compass direction of the tilt. North is 0° degrees, East is at 90°.

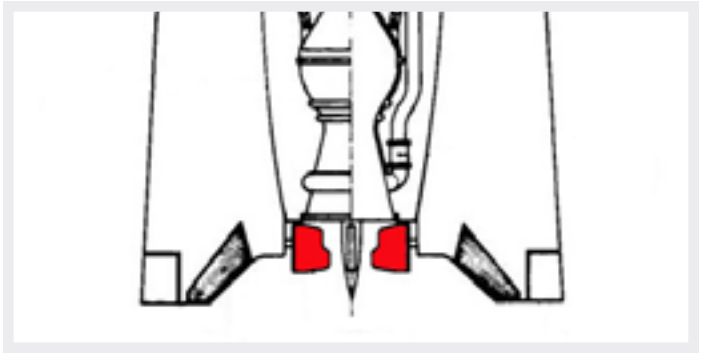


Figure 8 - Small Vanes in the exhaust stream alters thrust line

Why Bother With Offset Thrust at All?

Offset thrust allows rocketeers to explore "what-if" worlds that are difficult--or flat-out impossible--to create on the flying field. It is another tool that helps teach rocketeers valuable lessons about how rockets behave when forces aren't perfectly tidy.

In most single-motor models, the nozzle is placed dead-center along the centerline thanks to precision cut centering rings, so blaming a wild flight on an unintended cant is usually not particularly accurate. The only real-life exception we've seen came from a motor whose nozzle was partially blocked by a glob of slag; the thrust stream bent just enough to send the model into a drunken spiral. Incidents like that are rare. By bending the thrust line deliberately in RockSim-Pro, we can search those remote corners of the flight envelope.

This is priceless for designs like rocket boosted gliders. The lift force generated by a big, cambered wing is relentless, and throughout an entire flight, it will want to pitch the rocket up and make a giant loop before it slams itself into the ground. An offset thrust line, or a tiny downward cant in the motor, can bring the forces back toward equilibrium—at least during the boost phase of the motor in order to get the rocket high into the sky before the big pitch-up loop occurs.

Single-stagers without wings can be altered too, not because we're trying to "steer" them, but because pitch-roll coupling is fascinating to watch when it is created on purpose. Cant a fin two degrees to give it a lifting airfoil, and cant the motor another two degrees the opposite way (or offset it off the centerline of the rocket), and the model will corkscrew skyward like a fireworks shell. This was exactly how an old Estes kit called the Corkscrew worked. This trick can even be done in RockSim-Pro, and is precise enough to read exactly how tight the spiral will be, how much extra altitude there may or may not be, and whether the roll rate stays within the structural limits of the rocket fins.

Offset thrust truly begins to shine in cluster motor situations. The moment two or three motors are bolted around a central core, there is potential for an off-axis thrust component, even if the nozzle is pointed perfectly straight. Using RockSim Pro, the cant can be exaggerated on each motor tube, and moved towards or away from the center line. Watch the resulting flight on the screen before committing real motors to an idea that may prove unsuccessful.

Without even altering the pitch angle of the fins, a stabilizing roll can be induced into the rocket to give it an arrow straight flight even in breezy conditions. One of the most common reasons for angling the motor mount tube in the rocket is using a stabilizing roll to rifle the rocket like a spinning bullet.

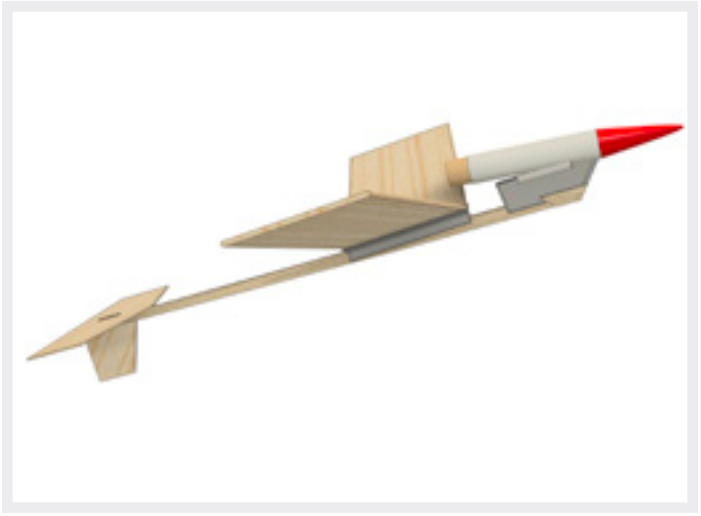


Figure 9 - Offset thrust lines are essential for glider rockets in helping keep forces at equilibruim during the flight duration.

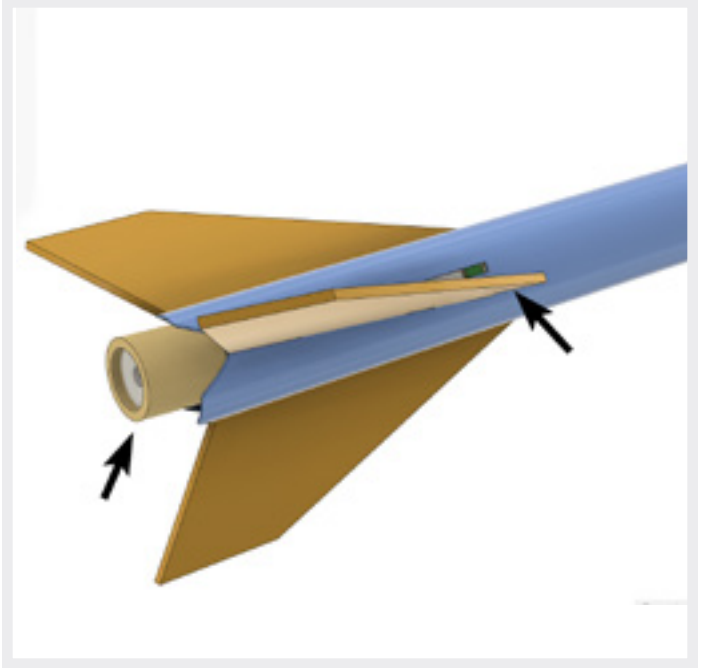


Figure 10 - Canting a fin can help give the rocket a lifting airfoil, and canting a motor too will make a corkscrew flight

How We Decoded the System

Our understanding of the offset thrust feature of RockSim-Pro came from countless simulations and observations of the flight path in the 3D Launch Visualizer. We began the journey of exploration with a simple, fin-stabilized, single-stage rocket that had a simulation environment set to zero wind. In this controlled setting, we could observe what happened when the Axis Error 1 value was gradually increased over time.

At first, with Axis Error 1 at 0°, the flight was textbook vertical. Then we introduced a slight cant of 5°, with the rotation set to 0°. Almost immediately, the 3D Launch Visualizer displayed a gentle arc, deviating from the rod as one might expect if a motor were misaligned. We increased the cant to 10°, and the curvature became more pronounced. However, when when the value was pushed beyond 10°, the rocket began to exhibit erratic behavior, tumbling uncontrollably and wrecking any semblance of a predictable trajectory.

We then experimented with Axis Error 2 by keeping a constant cant angle and rotating the assumed offset direction just to find out what it did. By varying this parameter in increments, we confirmed that the system responded as a basic polar coordinate: a rotation of 0° produced a southerly turn, while 90° shifted the turn west.

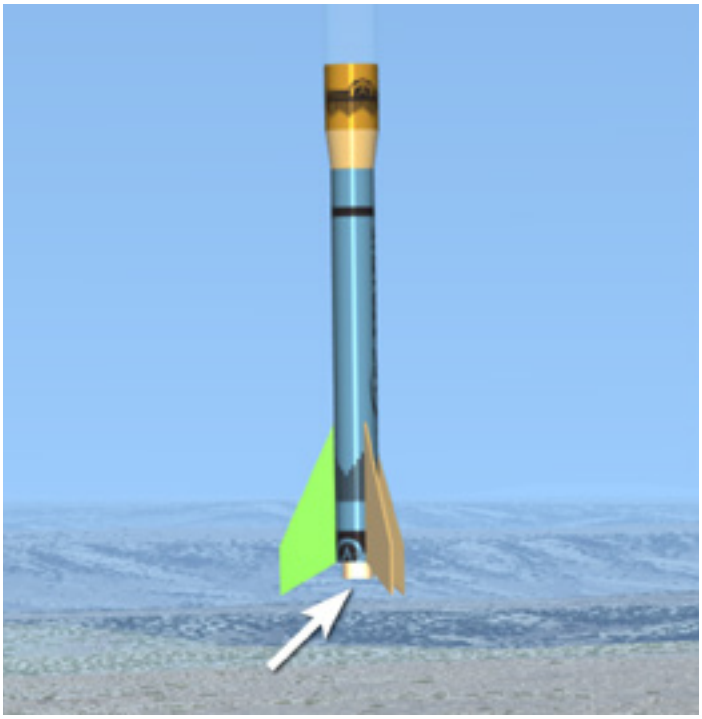


Figure 11 - The rocket motor doesn't look canted in RS Pro

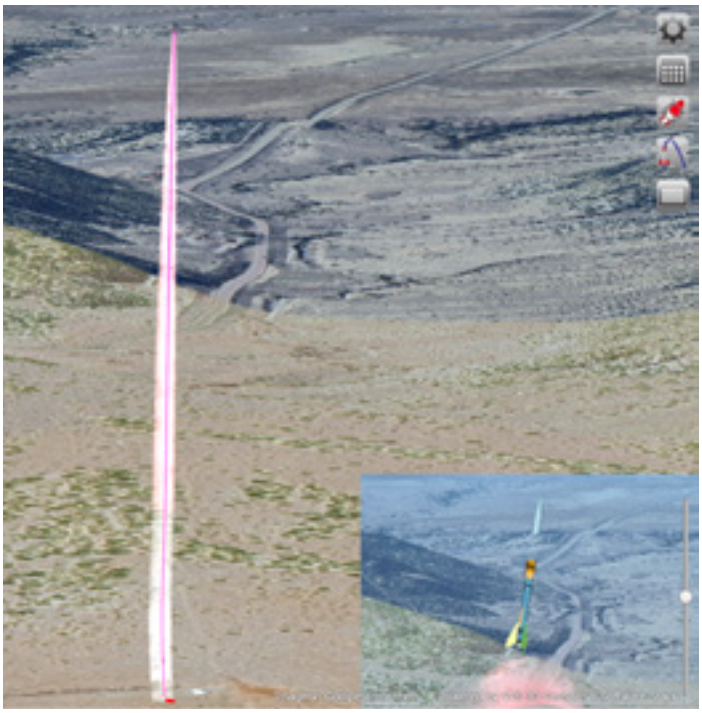


Figure 12 - Adding a slight cant with axis error 1 results in a gentle arc that deviates from the launch platform.

As previously mentioned, despite these clear angular deviations to the engine's thrust line, the rendered rocket engine never visually indicated the offset. It would have been a lot easier to wrap our heads around the "Axis Errors" if we could have seen the actual position of the rocket motor inside the vehicle. The next best thing was the 3D launch visualizer that is incorporated into RockSim-Pro. With it, "effect" of the inputs that were made to the axis angles are given a proper visual. The two trajectories can even be compared at the same time, helping rocketeers detect even the subtlest of changes to the flight path.

What became clear from these experiments is that the true value of offset thrust in RockSim-Pro lies in using it as an experimental probe to explore design boundaries and understand how small changes can dramatically affect flight behavior. It revealed how sensitive rockets are to small misalignments, and it highlighted the complex interactions between thrust vectors and aerodynamic forces. This knowledge enables rocketeers to proactively design for stability in complex configurations and push creative boundaries safely.

Advanced Applications

After a little practice getting a solid understanding of the basics, rocketeers can start using offset thrust in RockSim-Pro to explore unexpected flight behaviors and test the limits of more complex configurations such as clusters and winged hybrids.

Cluster Motors: Engineering Stability

Clusters add excitement and, inevitably, asymmetry. Even when every nozzle points perfectly straight, the moment two or three engines are arranged around a central core, the net thrust vector may no longer run through the rocket's centerline if one of the motors doesn't ignite. Instead, it passes somewhere off to the side. Under normal circumstances the equal-and-opposite thrust of all the motors cancels that offset and the stack flies true. But if even a single outboard fails to light, the balance is broken, and the live engines push from one side while the inert motor merely tags along, and the whole vehicle tries to pivot about its center of gravity. That instantaneous yaw often blossoms into a corkscrew-like flight path.

RockSim-Pro makes it easy to rehearse this drama without sacrificing hardware. Here's how to simulate a misfire of one of the motors. Instead of deleting the misfired motor from the file, add a "mass object" into its mount and set the weight equal to a fresh engine. This mimics that the tube still carries its proper ballast, but it produces no thrust. Load real motors in the remaining mounts and run the simulation. What will happen is the pure effect of an off-axis thrust line: how quickly the rocket begins to yaw, how much roll couples in, and whether the flight remains within the field's safety box. Use the "weathercocking cone" in the 3D Launch Visualizer as the safety box (guidelines) for determining if the rocket is going in a safe direction.

One effective strategy in cluster rockets, particularly when each motor is significantly offset from the central axis of the vehicle, is to angle all motors slightly toward the rocket's center of gravity (CG). By ensuring that even with one motor failure, the remaining engines' thrust vectors intersect just in front of the CG, the risk of uncontrolled torque is greatly minimized. In practice, simulate this by adjusting both Axis Error 1 and 2 for each motor and comparing the aggregate thrust line to the calculated CG. This might involve a bit of simple trigonometry—like using an arctan calculation—to determine the optimal cant. The goal is to recreate the conditions that produced the misbehavior, then adjusting the design accordingly to safeguard against it in future flights.

The Issue of Lift-Induced Pitch

Winged rockets, or boost-gliders, present their own challenges. Their wings generate significant lift during the boost phase,

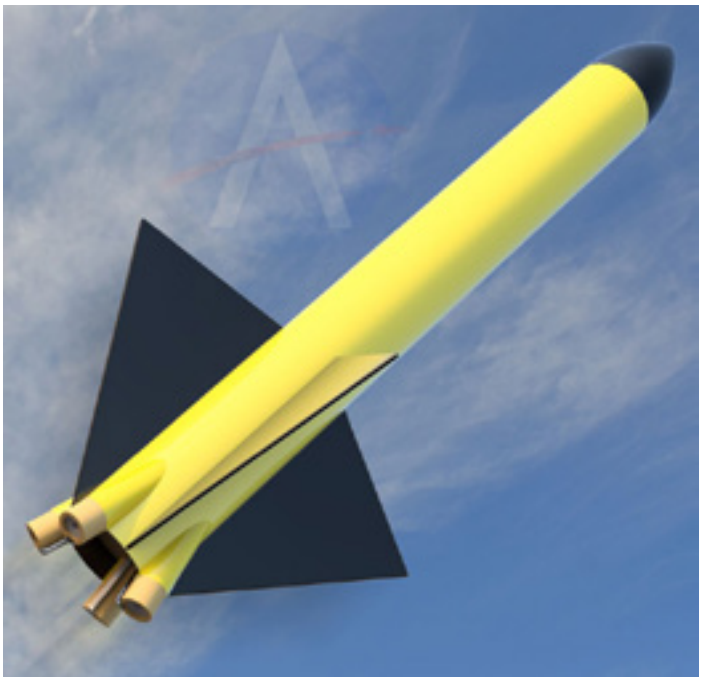


Figure 13 - Canting the motor tubes for cluster motors can help create a stabilizing roll flight, even when a motor fails.



which often causes an undesirable pitch-up. In simulation, try experimenting with a slight downward canting of the motor—start with a degree or two—to counteract this lift. The goal is to eventually get an "S" shaped trajectory where the rocket pitches down when the rocket is under thrust, and then pitches upward after motor burnout.

Also, try giving the rudder on the glider a slight tilt to induce a roll on the glider during ascent to straighten out the boost phase.

Again, the power of RockSim-Pro is with using its controlled environment. By comparing simulations--with and without slight offsets--rocketeers can get a clearer picture of how each variable affects flight. Use this insight to inform design modifications that will improve real flights, ensuring that the rocket behaves more predictably once it leaves the launch rail.

Why Every Rocketeer Should Simulate

Physical testing is invaluable, but it comes at a high cost--in both money and time. Every motor, every fin, every alignment error can lead to expensive setbacks. That's where simulation shines. RockSim-Pro offers a risk-free environment to explore the impact of minor misalignments and aerodynamic discrepancies.

Cost savings are immediate: instead of replacing motors or rebuilding airframes after a failed test flight, try running dozens of simulated scenarios for significantly less than the price of one actual flight. Time is also saved by bypassing weeks of physical prototyping. Most importantly, gain a deeper understanding of the physics at play--turning every simulated scenario into a learning opportunity. That knowledge enables rocketeers to communicate with fellow rocketeers about new approaches and potential pitfalls.

Conclusion

RockSim-Pro's offset thrust feature isn't really about solving yesterday's mysteries—it's about preparing for tomorrow's adventures. Rather than using it to understand why a flight went sideways, we harness it as a learning laboratory where we can safely explore the boundaries of what's possible in model rocketry. The true power lies in asking "what if" questions and getting answers without burning through motors or risking airframes.

For example, what if the boost-glider's motor was angled downward to counteract wing lift? What if we deliberately induced a corkscrew pattern by combining canted fins with offset thrust? What if one motor in the cluster fails to ignite? These scenarios would be prohibitively expensive--or downright dangerous--to test repeatedly in the field. But in RockSim-Pro, we can iterate through dozens of variations, refine our understanding of the physics involved, and emerge with designs that push creative boundaries while respecting safety margins.



The offset thrust tool transforms every simulation session into a masterclass in rocket dynamics. By experimenting with cluster motor arrangements, winged hybrid configurations, and artistic flight patterns, we build an intuitive grasp of how thrust vectors interact with aerodynamic forces. That knowledge makes us wiser builders.

Remember, offset thrust in the real world demands careful validation and respect for safety codes. But in the digital realm, we're free to explore, innovate, and learn from every virtual flight. Use this freedom freely. Let RockSim-Pro be the wind tunnel, test range, and gateway to understanding the subtle art of rocket design.

Most importantly, embrace the innate experimental spirit within model rocketry. Every simulation run, every offset angle, every virtual cluster failure teaches us something new about the delicate balance of forces that sends our creations skyward. That's not just good engineering—it's the joy of discovery made safe and affordable.



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 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 ezine newsletter about model rockets. You can email him by using the contact form at https://www.apogeerockets.com/Contact.





Killer Bee Rocket Plan

by Robert George

I would like to present the Killer Bee. I designed the Killer Bee in August of 2024. I wanted a rocket that I could attain my L1 certification with that wasn't a cookie cutter 3FNC design. I always liked the look of both the Centuri Hornet and the Estes Yellow Jacket, so I began wondering what a third rocket in the "series" would look like and the Killer Bee was born. This down scale is designed for great flights on easily obtainable Estes D12 and E12 motors.

Prepping the Plastic Parts

You'll need to cut the nose cone from the tail cone. Then cut the aft shoulder off the tail cone and cut off most of the tail cone forward shoulder, making sure to leave 1/4" inch of the shoulder. They should look like Figure 1 when you are done.

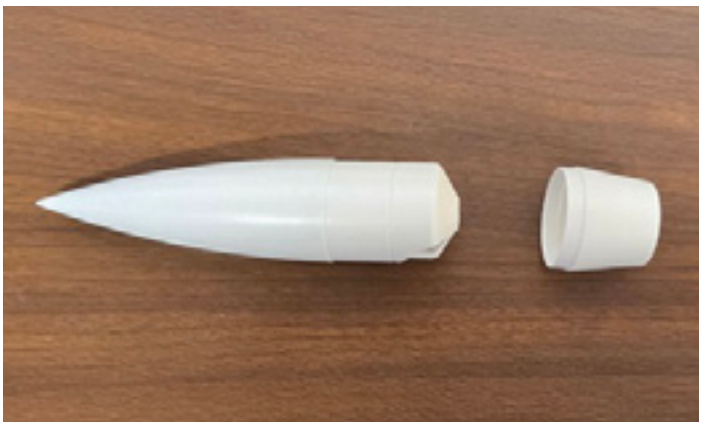


Figure 1: This is what your tail cone and nose cone should look like after performing the various cuts.

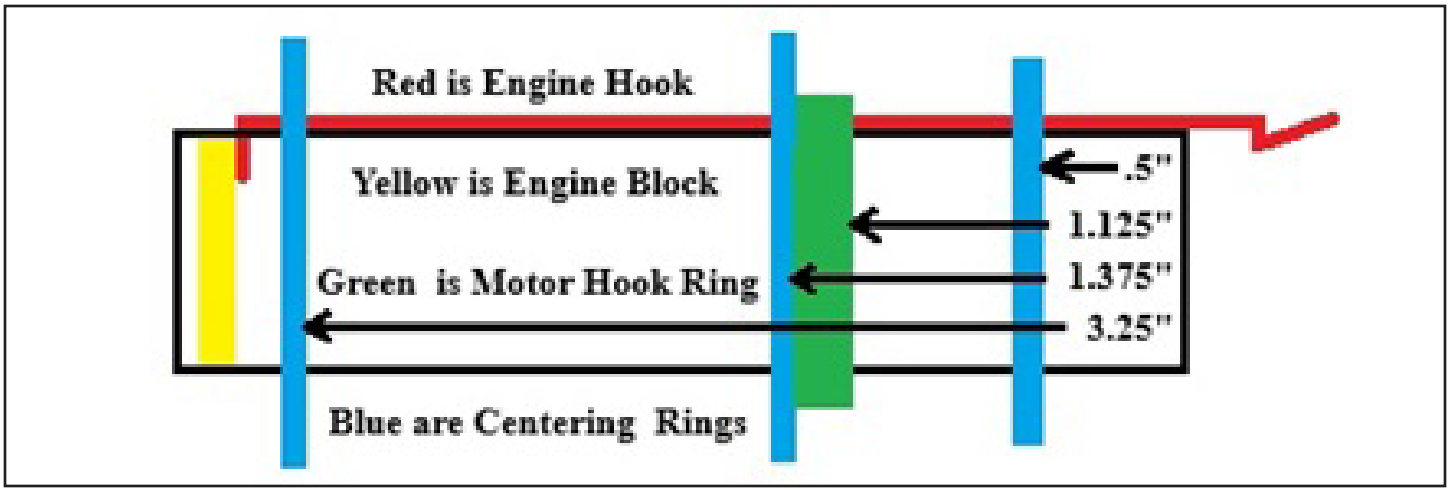


Figure 2: Assemble the motor mount using these measurements as guidelines

Motor Mount

Next we'll move to the motor mount. First you will need to make a 1/8" slot for the engine retainer hook 3 1/2" inches from the aft end of the motor tube. This is a good time to cut out a little clearance notch in the centering rings and the retaining hook ring for the engine hook. It only needs to be 1/8" wide by 1/16" tall.

Glue in the retaining hook ring 1-3/8" from the aft end. Next, slide the middle centering ring over the front and glue it against the retaining hook ring. Glue the forward centering ring into position 3-1/4" from the end of the motor tube, then glue the engine block into the motor tube—butting it against the engine hook. You have almost completed the motor mount and it should look like **Figure 3**.

Now it is time to install it in the body tube. First, make sure it will slide in. My centering rings needed a little sanding before they would slide in easily. Once you are ready apply glue inside the body tube and slide the assembly in until the green retaining hook ring is even with the end on the body tube as shown in **Figure 4.**





Figure 3: Completed motor mount assembly

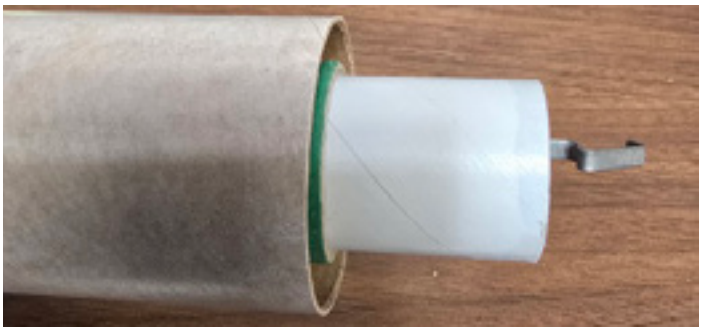


Figure 4: Retaining hook even with the end of the body tube



Figure 5: Check the position by inserting the tail cone into the body tube before the glue fully sets.

Before the glue sets, check the position by inserting the tail cone into the body tube. You should be able to push it in until the shoulder touches the body tube. Remove the tail cone right away.

Aft Centering Ring

It's time to make the aft centering ring. It is a bit of an odd size. The outside is 1-3/8" diameter and the inside is 24mm, just a smidge under 1 inch. You can use Payloadbay.com to print a template. I cut the one in the picture out of a heavy poster board with my hobby knife. Once the ring is made, you'll need to add a 3/16" x 3/16" notch for the engine hook, as shown in Figure 6.

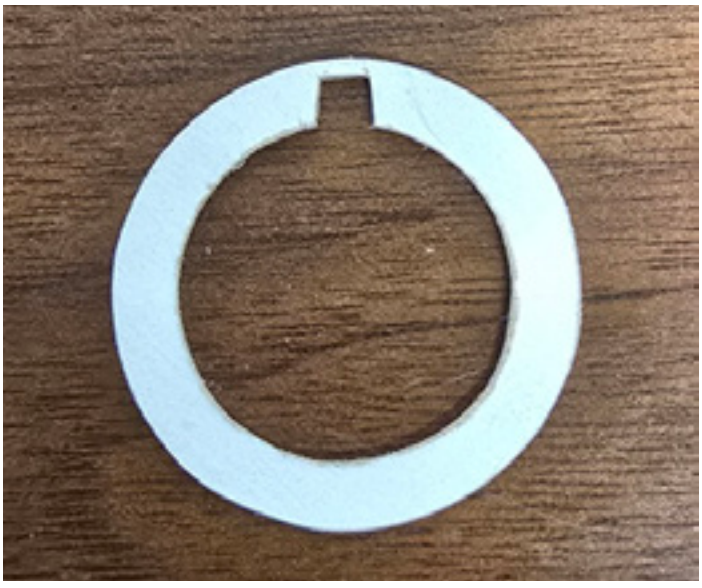


Figure 6: Add a 3/16" x 3/16" notch for the engine hook



Figure 7: Use the tail cone to position the centering ring

Next, position the centering ring on the motor tube and slide the tail cone on. This will show you where to glue the ring. It should be about ½" from the end.

Remove the tail cone and glue the centering ring in the correct position. Next you should roughen up the shoulder of the tail cone and lightly apply some epoxy to the inside of the body tube and the centering ring. A Q-tip or something similar works great for getting the epoxy inside the body tube. Install the tail cone.

This is a good time to fill the spirals in the body tube. I use thinned wood filler that I apply with a small brush. I use a brush to apply it sparingly and work it into the spirals. It's also good for smoothing over the joint at the tail cone.



Figure 8: Fill the spirals on the body tube now, if desired



Fins

While that dries, we can work on the fins. Use the template to make a guide to cut out the pieces. I like to make my guides out of poster board so I can use them to cut multiple fins the same exact size.

Once the guides are ready, you can lay them on the balsa and go around the edges with a new blade and cut out the fins. Keep your blade straight up so you have a square edge to glue.

Once I get all the parts cut out, I'll stack them and sand them to the same size. I use binder clips to hold three sides and sand the fourth, then I'll move a clip and sand the new side until all sides are done.



Figure 9: Fin templates made out of poster board





Figure 10: Use the guides to cut out the fins



Figure 11: Use 3 binder clips to hold the fins together, and sand the unclipped side so that they all match



It's papering time. There are many ways to do this and **Tim does have two videos on YouTube** about it but mine is a little different so I thought I would show it to you. Avery makes full page label paper and Staples has it in their own brand—either works.

ACV #16: *https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_16*

ACV #381 *https://www.apogeerockets.com/Advanced_Construction_videos/Rocketry_Video_381*



Figure 12: Avery has options for full page label paper



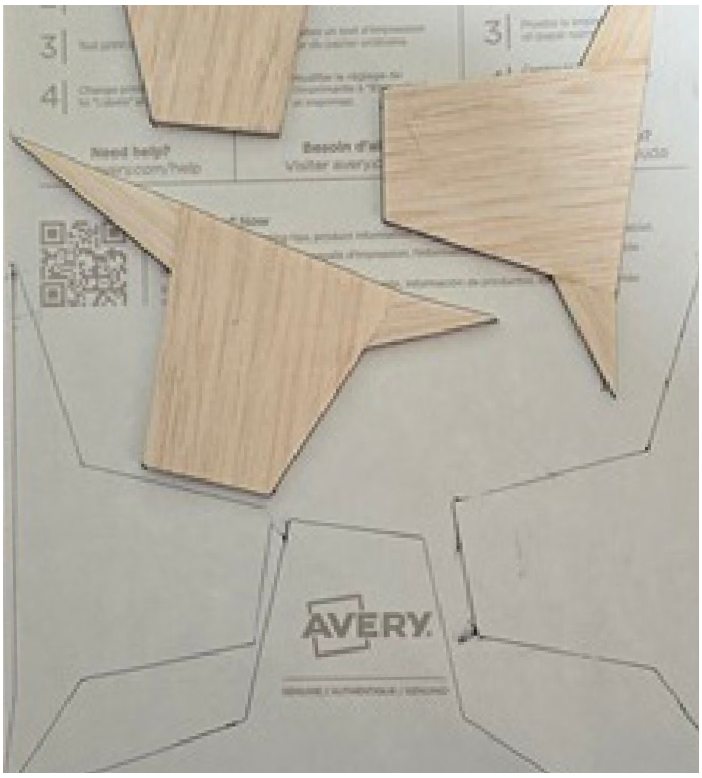


Figure 13: Leave a little offset around your fin tracings.

Lay out your fins on the backside of the paper and trace them out. Make sure to flip them over so you have three right and three left sides as shown in Figure 13.

Cut the skins to the line on the root edge but leave a little extra on the other edges.

Now it's time to prep the fins. First you need to sand the surfaces flat. You can use thinned wood filler to fill any dents.

Now you'll need to get the dust off the fins. I use some masking tape and just dab/wipe the surface to remove the dust.

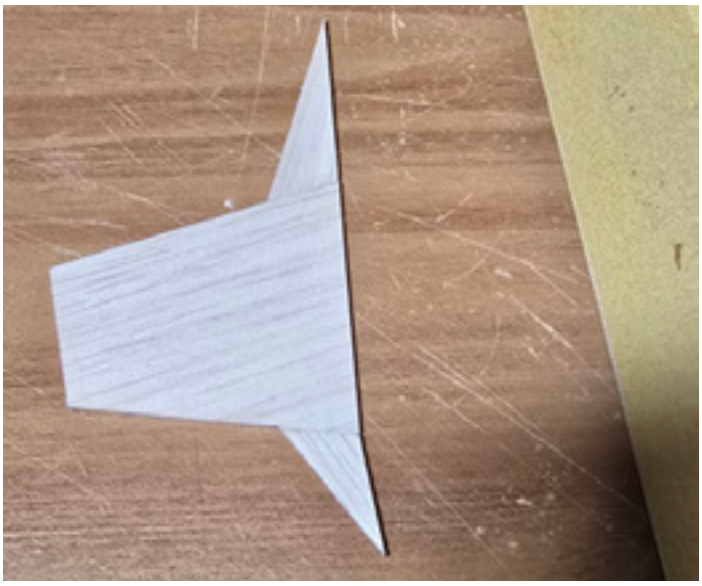


Figure 14: Sand the surfaces flat and fill any surface dents



Figure 15: Use some masking tape to get any dust off the fins



Pull the backing paper off while trying not to touch the adhesive side and apply the paper to the fin. Leave about 1/8" of the root edge exposed so the fillets can grab the wood. Press the paper down on the wood with your finger radiating out from the middle for a wrinkle free skin.
Once the skin is on, flip the fin over and trim off the excess paper.

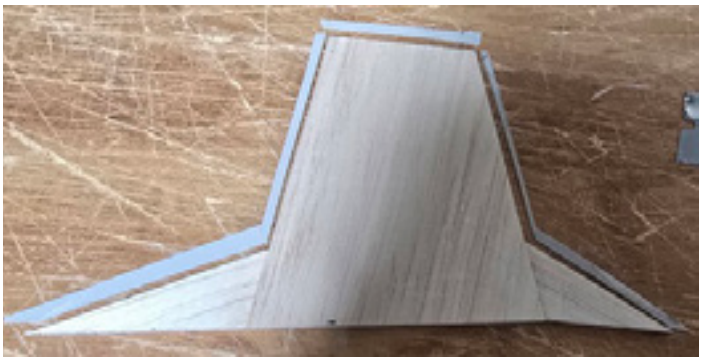


Figure 16: Trim off the excess paper around the fins

Apply the paper to the second side and trim off the excess paper. I use a sanding bar to trim the rest of the paper off the fin. The sanding bar has 220 grit paper and I hold it at a 45 degree angle and lightly push away from the fin. It will cut the paper and start a rounded edge. Go slow and watch for a change of color.

I'll finish rounding out the edges with 220 grit sandpaper by hand until I am happy. Go slow and take your time with this.

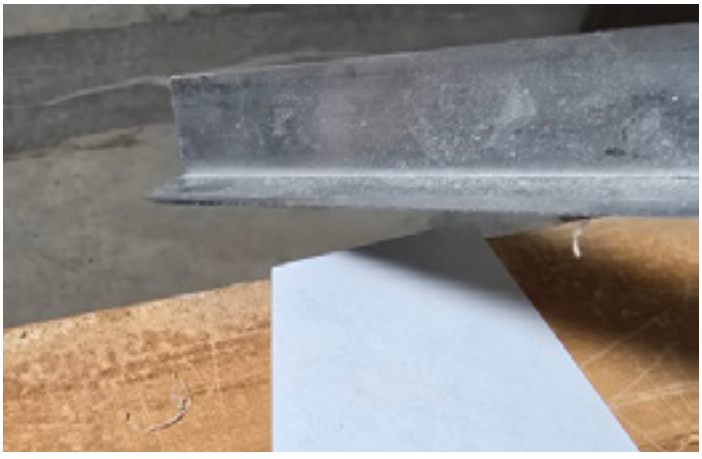


Figure 17: Sanding the fins with 220 grit at a 45 degree angle





Once you are happy with the fins, it's time to seal the edges. Run some thin CA glue over the paper edges and wipe away any excess with a tissue. Just swipe with the tissue, do not stop. Also, do not apply CA glue to the root edge. The glue fillet will seal that edge later in the build

The filler on the body tube should be dry by now so it's time to sand. You might want to take it outside as this step creates a lot of dust. I sand mine lightly with 180, followed by 220 grit to prep the tube.

Figure 18: Seal the fin edges with some thin CA glue.





Installing the Laundry Shelf (?)

This is a good time to install the laundry shelf. I cut 1/2" off a coupler and use one of the plates from the baffle kit to make mine. I've used a 1-3/8" screw eye and I coated the plywood with thinned epoxy.

I attached the Kevlar cord and glued the shelf in place 10 inches inside the body tube by using a dowel to spread the glue inside the body tube then I used a BT20 body tube to push it into place. Be sure to push it in with one movement, or it might "lock in" before you reach the 10 inches.

Figure 19: Coat the plywood with thinned epoxy for strength





Attaching the Fins

Payloadbay.com has a fin wrap tool and a fin guide tool to help get the fin alignment correct. Alternatively, you can use the included fin wrap. I use Titebond II to attach the fins. Once the fins are dry, I like to use Titebond Quik and Thick to make the fillets. Use a wet finger to smooth the bead of glue into a nice fillet.

Launch Lugs

This is also the time to add the launch lugs. Use two 3/16" (or 1/4") lugs cut to 1" long. Put the lower one at the end of the body tube and the upper one so the bottom of it is 5" from the end of the body tube.

Paint Prep and Decals

Next it is time to prep for paint. My nose cone needed a small amount of filler after sanding the seam. I used Bondo spot putty to fill in the low spots.

I gave the rocket one final sanding with 400 grit sandpaper then sprayed it with my favorite primer. This showed all the fuzzies and other areas that needed attention. Once they were sorted out, I sprayed primer again and gave that a light sanding to prep for the colors. I sprayed the yellow first and let it set until it was safe to spray the black. Once it was ready, I taped off the yellow and sprayed the black. Refer to the diagram for the tape placement. Then I added the decal and when it was safe to do so, I sprayed the rocket with a clear coat starting with a light coat first. Install the recovery gear and go fly!



Figure 20: Use epoxy for string fillets around the fins



Figure 21: Apply wood filler to your nose cone if necessary



Parts List

Part#	Description	Order Quantity
10141	41.6mmx18" Body Tube (Estes BT-60 Size) (6pk)	1 (Need 1 x Tube)
12009	Motor Mount Kit 24mm/BT60 - Cardstock Rings	1
12162	BT-60 (41.6mm) Ejection Charge Baffle	1 (Need 1 x Disk)
13057	1/4" Launch Lug (6pk)	1 (Need 1 x Launch Lug)
14097	Balsa Sheet - 3/32" x 3" x 18"	?
20069	PNC-41.6/BT-60 and BT-60 to BT-55 Transition	1
24049	'E' Sized Engine Hooks (6pk)	1 (Need 1 x Hook)
29092	18" Printed Nylon Parachute	1
30325	Kevlar Cord 100#	10
44002	Centering Ring Cardstock	1
—	Avery/Staples Label Paper (from office supplies store)	Need 1 Sheet



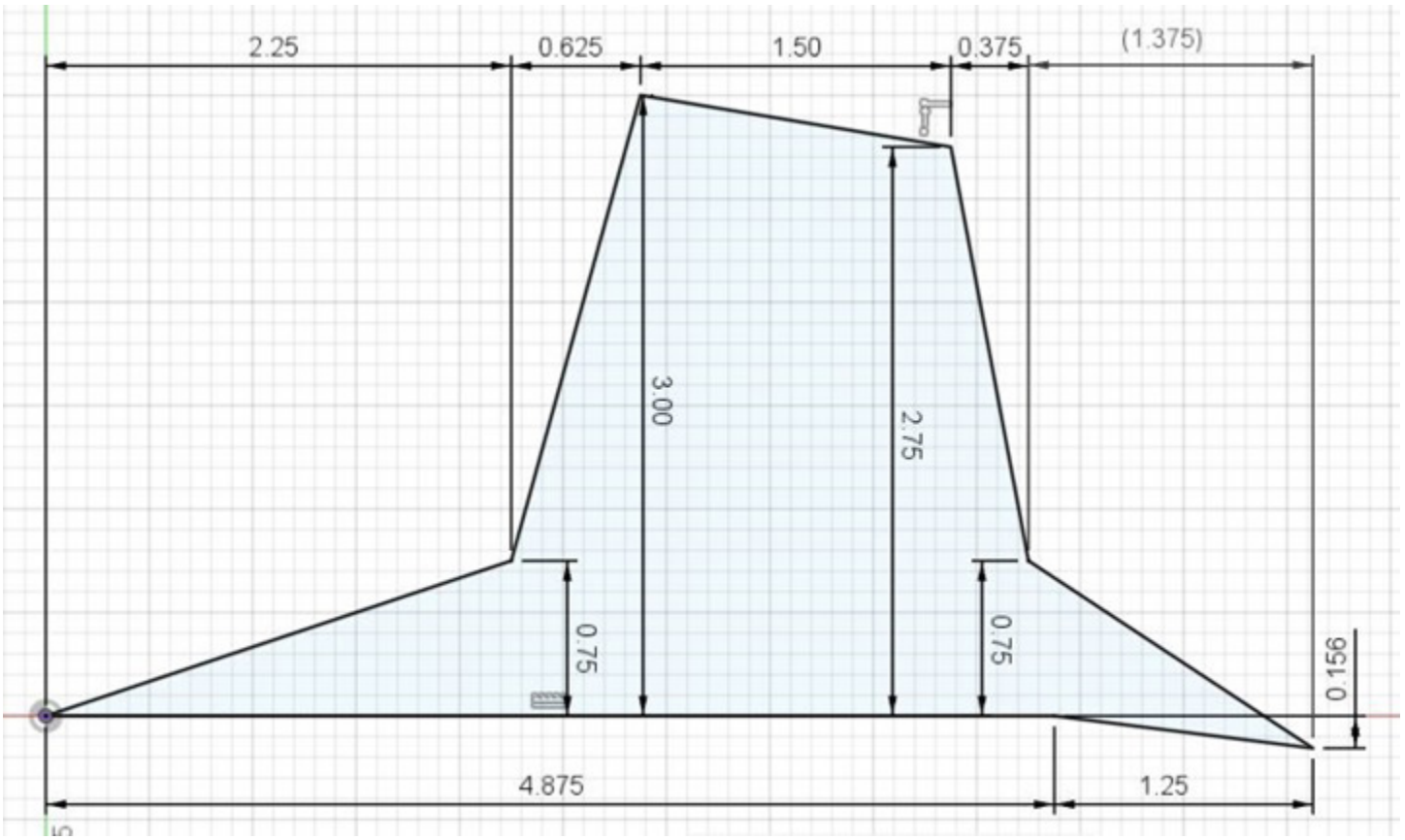
Robert George with a completed Killer Bee Model Rocket



Templates



KB16 Tape Layout



KILLER BEE

Download the RockSim File Here:
https://www.apogeerockets.com/Peak-of-Flight-Rocket-Plans

PEAK OF FLIGHT NEWSLETTER

Article Submission Guidelines

Issue 654 / June 17th, 2025

www.ApogeeRockets.com

SUBMITTING ARTICLES TO APOGEE

We are always looking for quality articles to publish in the *Peak-of-Flight* newsletter. Please submit the "idea" first before you write your article. It will need to be approved first.

When you have an idea for an article you'd like to submit, please use our contact form at **https://www.apogeerockets.com/Contact**. After review, we will be able to tell you if your article idea will be appropriate for our publication.

Always include your name, address, and contact information with all submissions. Including best contact information allows us to conduct correspondence faster. If you have questions about the current disposition of a submission, contact the editor via email or phone.

CONTENT WE ARE LOOKING FOR

We prefer articles that have at least one photo or diagram for every 500 words of text. Total article length should be between 2000-4000 words and no shorter than 1750 words. Articles of a "how-to" nature are preferred (though other types of articles will be considered) and can be on any rocketry topic: design, construction, manufacture, decoration, contest organization, etc. Both model rocket and high-power rocket articles are accepted.

CONTENT WE ARE NOT LOOKING FOR

We don't publish articles like "launch reports." They are nice to read, but if you don't learn anything new from them, then they can get boring pretty quick... Example: "Bob flew a blue rocket on a H120 motor for his certification flight." As mentioned above, we're looking for articles that have an educational component to them, which is why we like "how-to" articles.

You can see what articles and topics we've published before at: **https://www.apogeerockets.com/Peak-of-Flight?pof_list=archives&m=education**. You might use this list to give you an idea or two for your topic.

Here are some of the common articles that we reject all the time, because we've published on these topics before:

- How to get a L1, L2, or L3 Cert
- Building cheap rockets and equipment (pads & controllers)
- How to 3D print parts, or a Rocket Kit
- How to Build a cheap Rocket Kit
- Getting Back Into Rocketry After a Long Hiatus

ARTICLE & IMAGES SUBMISSION

Articles may be submitted by emailing them to the editor. Article text can be provided in any standard word processor format, or as plain-text. Graphics should be sent in either a vector format (Adobe Illustrator, SVG, etc.) or a raster format (such as jpg or png) with a width of at least 600 pixels for single column images or 1200 pixels for two-column images. It is preferable for images to be simple enough to be readable in a two-column layout, but special layouts can be used.

Send the images separately via email as well as show where they go by placing them in the word processor document.

ACCEPTANCE

Submitted articles will be evaluated against a rubric (available here on our website). All articles will be evaluated and the results will be sent to the author. In the evaluation process, our goal is to ensure the quality of the content in *Peak-of-Flight*, but we want to publish your article! Resubmission of articles that do not meet the required standard are heavily encouraged.

ORIGINALITY

All articles submitted to Peak-of-Flight must not run in another publication before inclusion in the *POF* newsletter, but it may be based on another work such as a prior article, R&D report, etc. After we have published and paid for an article, you are free to submit them to other publications.

RATES

Apogee Components offers **$300** for a quality-written article over 2,000 words in length. Payment is pro-rated for shorter articles.

WHERE WILL IT APPEAR?

These articles will mainly be published in our free newsletter, *Peak-of-Flight*. Occasionally some of the higher-quality articles could potentially appear in one of Tim Van Milligan's books that he publishes from time to time.



PEAK OF FLIGHT NEWSLETTER

Issue 654 / June 17th, 2025

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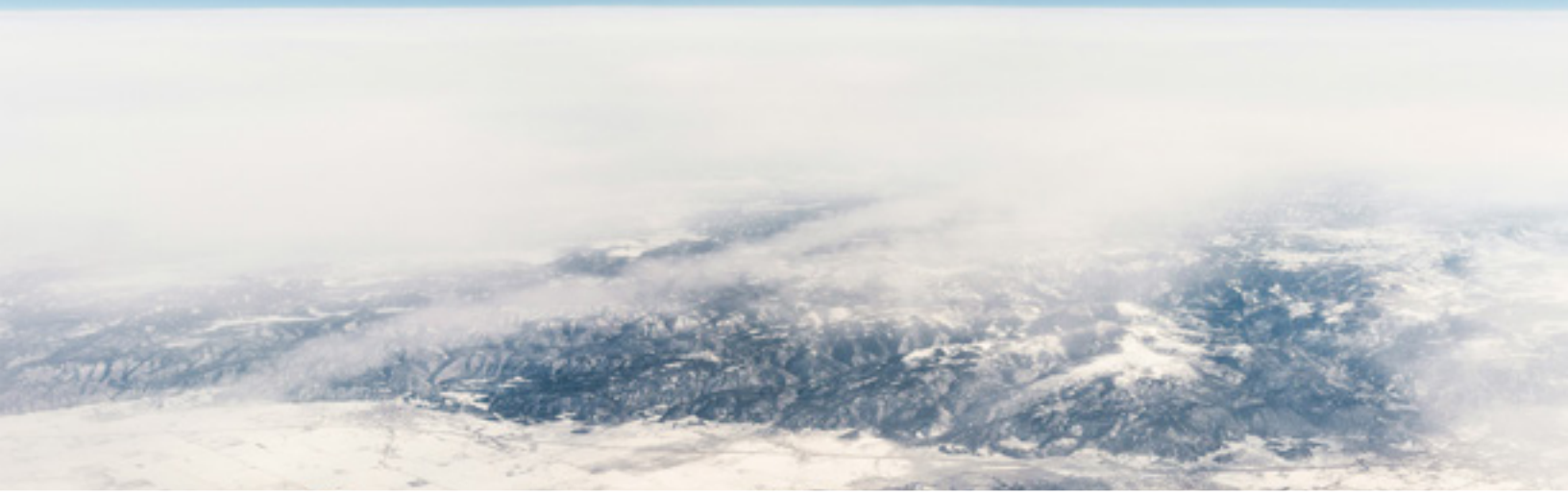
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