PEAK OF FLIGHT NEWSLETTER

Issue 660 / September 9th, 2025

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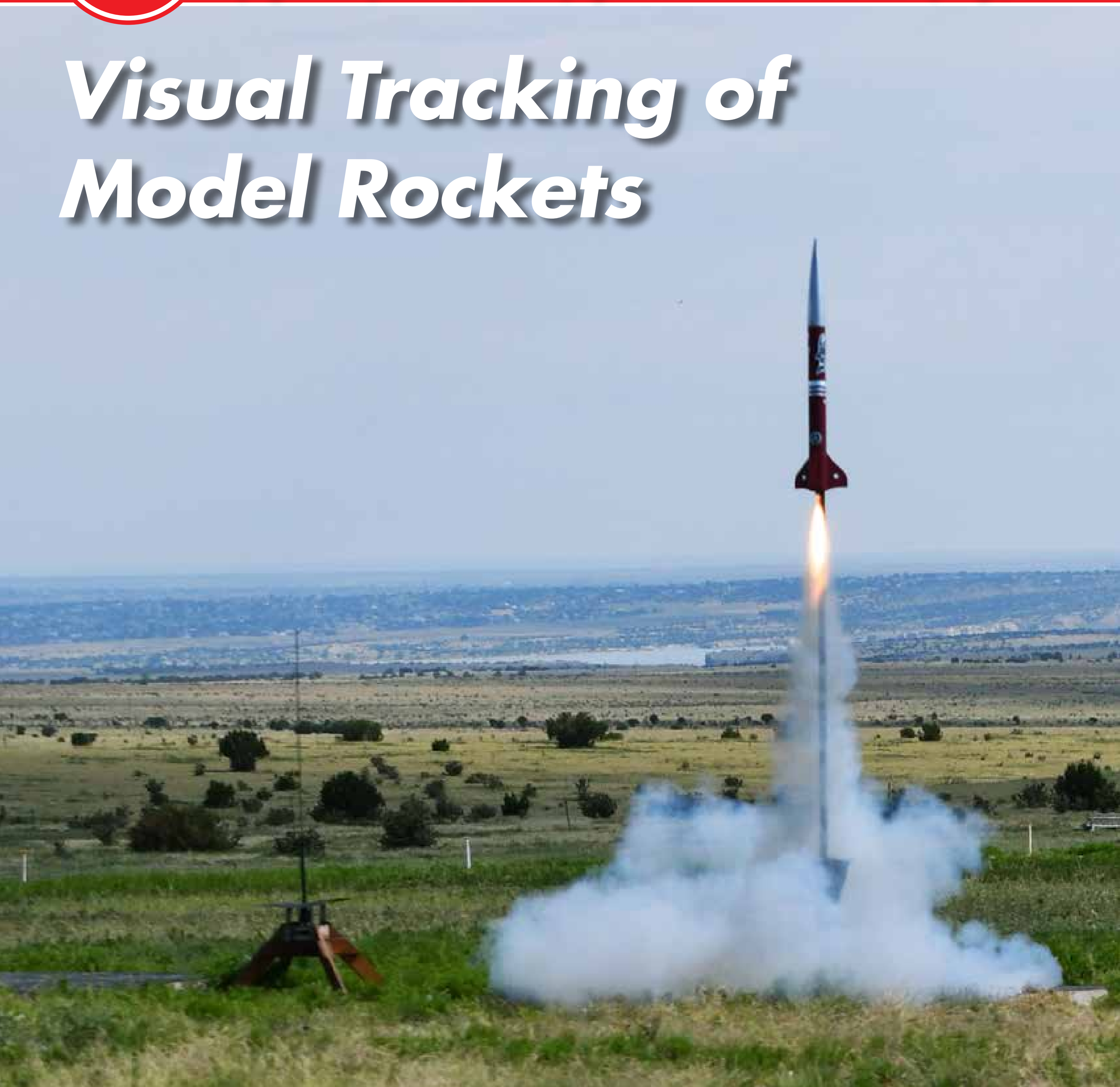
Visual Tracking of Model Rockets



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COVER PHOTO

The Mako

While it doesn't look like it, this is actually a cluster of two F-20 engines in the Mako rocket kit. This was one of the Mako mods that was covered in Advance Construction Video #442.

FEATURED ARTICLES

Visual Tracking of Model Rockets

by Jorge Daniel Bonanno

What is the cheapest way to get your rocket back without an expensive GPS tracker? In this article, you'll see there are cheap ways to get your rocket back..

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About this Newsletter

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Editor-in-Chief: Tim Van Milligan
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The Apogee Saturn 1B rocket ready to fly.

Would you like to see your launch photo featured in the *Peak-of-Flight* newsletter? Submit your photo at apogeerockets.com.

Visual Tracking of Model Rockets

By Jorge Daniel Bonanno

Anyone who practices model rocketry knows that once the parachute deploys—a key element of a successful flight—the most important thing is to keep visual contact with the model in order to recover it. The basic idea is to never lose sight of the rocket as it descends, because if you do, you run the risk of losing it entirely and not knowing where it might have landed.

Nowadays, we have electronic tracking solutions thanks to GPS (https://www.apogeerockets.com/Electronics_Payloads/Rocket_Locators), which allow us to locate any object anywhere in the world. Although tracking devices have become quite miniaturized, their use is typically limited to rockets with a certain body diameter that can house them conveniently, and with motors powerful enough to carry them without compromising altitude. But what happens with small-diameter models powered by low-thrust engines where the goal is to minimize final weight? And worse, what if it's a competition model where weight directly affects altitude and time aloft? In those cases, tracking must rely entirely on visual observation until the rocket touches down. In competitions, recovering the rocket is just as important as reaching a good height or long flight time, because you must return the model to the judges for evaluation.

We will start by discussing the obvious, then move on to technique and method.

It is essential that more than one person observes the flight closely. As the saying goes: "Four eyes are better than two." If someone loses sight of the rocket, others may still follow it and maintain the descent direction.

First, you must follow the visual path or line that marks the rocket's trajectory, which usually matches the wind direction and causes the drift.

Second, determine the landing point and immediately fix a nearby visual reference to mark the direction you will "walk" to recover the rocket. Although this sounds easy, in practice it's difficult. Estimating the bearing (direction) is relatively simple—it's an imaginary line from the launch pad to where the rocket lands—but estimating the distance is much harder. Our depth perception makes it difficult to judge how far the rocket has drifted. A good strategy is to note landmarks in the direction of descent, such as a specific tree, house, power line, etc.

But why, even if we've followed the model all the way to the ground and identified a landing reference, do we often fail to find it once we head out to recover it? Here are some reasons and why a method is necessary.

First, let's look at how much we deviate when estimating a direction “by eye.” In Figure 1, A is the launch pad and B is the landing point. When walking, we tend to deviate from the original course by an angle (α), which leads us to point C (see Figure 1).

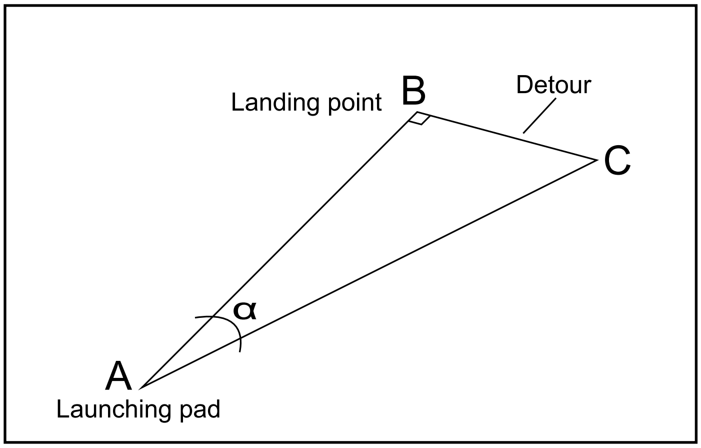

Figure 1 - How for you'll end up off course even if you're only 1° off.

Using simple trigonometry:

$\tan(\alpha) = BC / AB$

If we take α as 1° for a distance of 100 m:

$\tan(1°) = 0.017 = BC / 100\ m$

Therefore, BC = 1.7 m

That means we deviate 1.7 meters for every degree of error.

Taking a more realistic example, suppose the rocket landed 400 meters from the pad and we err by 20° (quite normal without instruments). Then:

$\tan(20°) = 0.363 = BC / 400\ m$

The deviation will be:

BC = 145 m

This is a large enough distance to easily miss the rocket.

Many people underestimate how large this error can be. Scientific studies with walkers—especially in activities like trekking—show several common causes for such deviations:

- Biomechanical differences in legs: Often one leg is slightly longer, causing one foot to “step” more than the other, which leads to gradual veering.

- Dominant side of the body: Being right- or left-handed can bias your walking direction.
- Lack of clear external visual references: It's easy to walk straight down a hallway with clear midline, but very difficult to keep a straight path in open fields or tall grass.
- Uneven terrain: Obstacles on the path force detours, and which way you go depends on personal preference.
- External factors such as side winds: These can push you left or right while walking.

All these asymmetries cause your walking path to curve slowly away from the intended line, sometimes resulting in a circular route over longer distances.

If you walked while only looking at the ground, without horizon references, you'd find yourself walking in a curve within just a few hundred meters (see Figure 2).

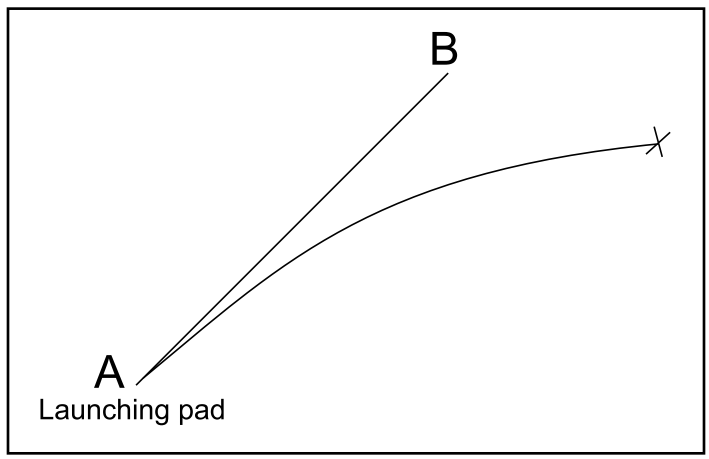

Figure 2

With these concepts in mind, we propose a method that, while based on observation, is not exact but greatly reduces human errors caused simply by walking. This method uses a time-tested measuring instrument: the compass.

THE COMPASS

As we know, Earth behaves like a giant magnet with two opposite magnetic poles, North and South, creating a magnetic field over the planet's surface.

A compass is a device with a magnetized steel needle that rotates horizontally on a low-friction pivot and always points to magnetic north.

Behind the needle, there is a graduated circle called the dial or bezel. Some compasses have the needle suspended in a liquid-filled chamber to dampen oscillations and stabilize readings.

TYPES OF COMPASSES

There are many types of compasses, but here we focus on the two that best suit our needs: basic compasses and sighting compasses. Smartphone compasses can also be used.

BASIC COMPASS

It consists of a magnetized needle suspended over a graduated dial with a fixed base. These are simple but adequate for distances of about 2 to 3 kilometers. (See Figure 3.)

Figure 3 - The basic magnetic compass

SIGHTING COMPASS

This type was adopted by several military forces, including the United States. It is robust, reliable, and features a sighting window with a magnifying lens for easy scale reading. (See Figure 4.)

Figure 4 - The sighting compass

MAGNETIC DECLINATION

It is important to note that compasses point to magnetic north, which does not coincide exactly with geographic north. Since we will only measure bearings relative to magnetic north and not use maps, this difference will not affect our short-range tracking.

BEARING AND AZIMUTH

a) ***Bearing:*** Defined as the angle between any direction and magnetic north. It is a measurement taken on the ground with reference to magnetic north, using the compass. It is measured clockwise.

It is useful to know that the reciprocal bearing, or back bearing, is calculated by adding 180° to the bearing. This corresponds to the opposite direction of travel.

b) ***Azimuth:*** The angle between a given direction and geographic north. Since we treat magnetic north as equal to geographic north, the concept of azimuth coincides with bearing.

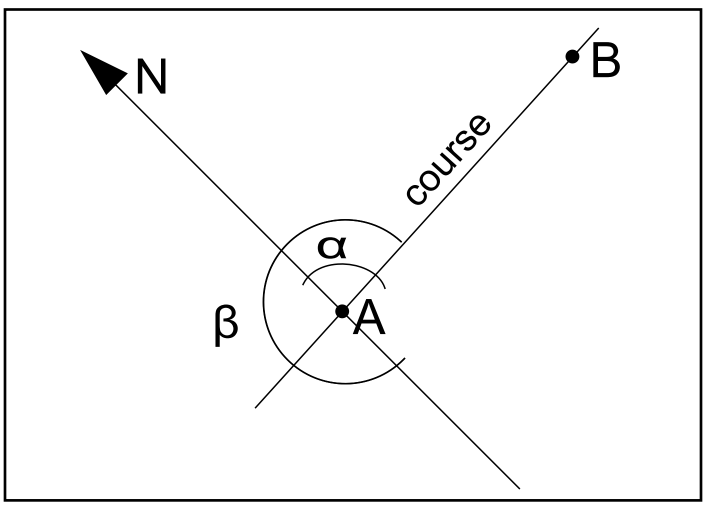

Figure 5

In Figure 5, we see magnetic north (indicated by the compass) and the bearing (the line between the launch pad and the observed landing point). The azimuth angle (α) and the back azimuth (β) are defined, where β = α + 180°.

For example, if we point to the landing point and measure an angle of 70° relative to north, the back azimuth will be 70° + 180° = 250°. This means that if we are walking toward the landing point on a bearing of 70° and then turn around 180° to face the launch pad, the compass should read 250°.

This basic method helps us correct deviations as we walk.

Let's summarize the method with an example for clarity.

Referencing Figure 6, suppose you are at the launch pad and point the compass to the rocket's landing site, measuring a bearing of 70° relative to magnetic north. You set this bearing on the compass dial, and thus, the back azimuth is 250°.*(which is SW of due West).*

You also identify a visual landmark in this direction, like a tree, house, or distant post. You begin walking towards this landmark, checking periodically to ensure you stay on course and don't drift due to natural walking tendencies.

To verify your course, stop midway, turn 180°, and point the compass towards the launch pad. The compass should read the back azimuth, 250°. Two cases may arise:

If the compass reads greater than 250°, you are veering right of your path. Rotate your body right until the compass reads 250°, which realigns you on the correct path.

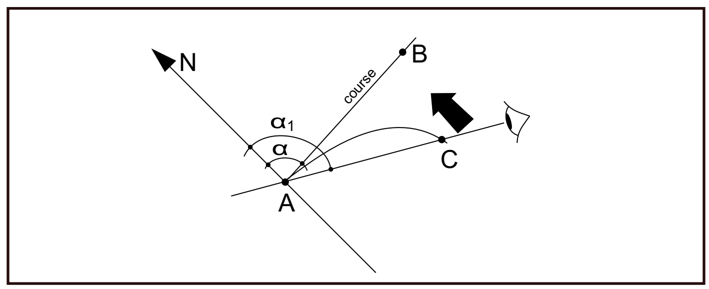

Figure 6 - Bearing right off the correct path

If the compass reads less than 250°, you are veering left. Turn left until the compass reads 250°, correcting your direction.

This straightforward approach allows continuous correction of natural walking deviations. Practice in open fields is recommended to get comfortable using the compass and aligning with the launch pad while walking.

It is crucial to visually identify the rocket's landing point because it determines the angle relative to magnetic north and the bearing you will follow. Of course, incorrectly measured angles cause tracking errors, so we can't guarantee finding the rocket within 1 meter, but we have consistently located models within a 10-meter radius using this method.

This approach is always better than relying solely on visual observation. The only equipment needed is a compass to check and correct your course as you walk. No onboard devices that add weight are necessary, so it doesn't reduce flight altitude or airtime.

The method is simple, effective, and economical. Once you have a compass, no other costs are associated with model recovery.

Why is it important to align with the launch pad to correct your course?

When you start walking along your bearing, the clearest reference point you have is the launch pad. Imagine walking toward your target without checking the back azimuth to the launch pad; you will inevitably drift to one side (see Figure 7).

For example, if you are at point F and measure 70°, you are walking on a line parallel to your intended bearing but in a direction that will take you away from your target. Continuing to point G and still reading 70°, you will be getting farther.

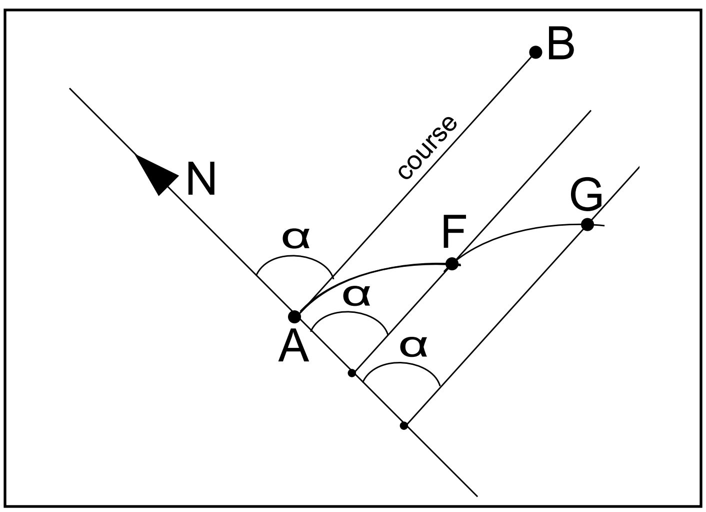

Figure 7 - If you don't check the back azimuth, you could end up drifting off the line.

Therefore, it is essential to check your bearing by sighting back to the launch pad.

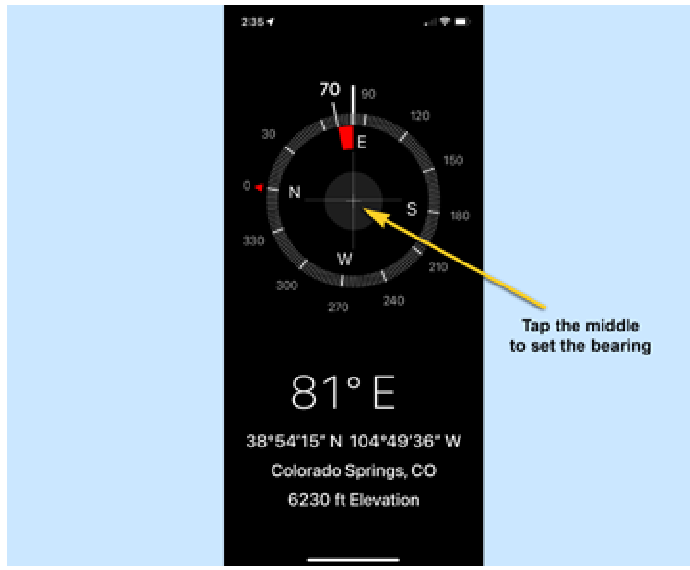

Figure 8 - Using the compass app on your iPhone, you can set the bearing by tapping in the middle. Then when you walk, you'll get a red indicator (shown top-middle) letting you know you're off course.

Adding Technology

Your smart phone also contains a compass that can help you to stay the course as you're walking towards your rocket.

Open the compass app, and then hold your iPhone flat to align the crosshairs at the center for accurate bearings. With the crosshairs aligned, point the phone at the rocket where it landed. The current heading is now shown at the top

To lock your current direction, tap the compass dial in the middle—if you move off course as you're walking, a red band appears, helping you stay oriented.

As shown in Figure 9, the red band is to the right of the set heading of 70°, indicating that we've drifted off of the correct course to walk towards the rocket.

Also noted that your exact coordinates and elevation appear at the bottom. If you tap on them, and you have cell coverage, it will bring of the map of your current location.

Dealing with Obstacles

Let’s see how to proceed if you encounter an obstacle or if your rocket lands behind something like a tree line blocking your view.

Although you didn't see the exact landing point, you can still determine the direction of drift and measure the bearing angle relative to magnetic north.

You can also use binoculars to scan the area where you lost sight of the rocket, looking for distinct features (a taller tree, a leaning tree, a gap in the trees) to help when you get close.

Assume you took the bearing AB and measured an azimuth angle equal to 70°, as in the previous example (see Figure 10).

The process could be:

Walk following the 70° bearing line AC. If the path is long, periodically verify your bearing by turning 180° and sighting back to

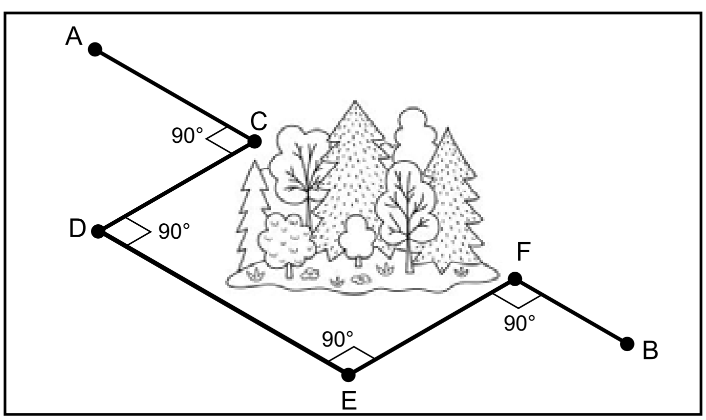

Figure 9

the launch pad, ensuring the back azimuth reads 250°. Adjust left or right as needed to maintain the correct path.

Upon reaching point C (near the obstacle), check the back azimuth again; this point must be as precise as possible because you can no longer use the launch pad as a reference.

Turn 90° right, adding 90° to your original bearing (70° + 90° = 160° on the compass dial). Count your steps while circumventing the obstacle until you reach point D.

At point D, turn 90° left (subtract 90° from the dial). The compass should read 70° again because you are walking parallel to the original bearing AB. Walk until point E, which allows you to bypass the obstacle (no need to count steps here).

At point E, turn 90° left again. On the compass dial, this corresponds to 340° (since 70° - 90° = -20°, adding 360° gives 340°). Walk the same number of steps as from C to D, arriving at point F.

Finally, turn 90° right, which should bring the compass reading back to the original 70°. From here, walk straight towards your target.

This method is commonly used in hiking for much longer distances than model rocketry.

Finally, it's not a bad idea for modelers to complement this method with small audible beacons available on the market (https://www.apogeerockets.com/Electronics_Payloads/Rocket_Locators). These are low-cost devices that can help locate the model when you are near the landing zone.

About the Author

Jorge Daniel Bonanno is an Argentine aeronautical engineer and amateur writer born in 1962. He has been practicing model rocketry since 1973.

He participated in the creation of the first model rocketry school in Argentina and was an instructor and winner of several local championships.

He has always promoted and supported the activity and was president of ACEMA (Argentine Association of Experimental and Model Rocketry. https://www.acema.com.ar/) and is an active member of the Tripoli prefecture, having held Level 2 certification for over 10 years.

He currently participates in the association's model rocketry activities, supporting future generations of rocketry makers.

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.

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