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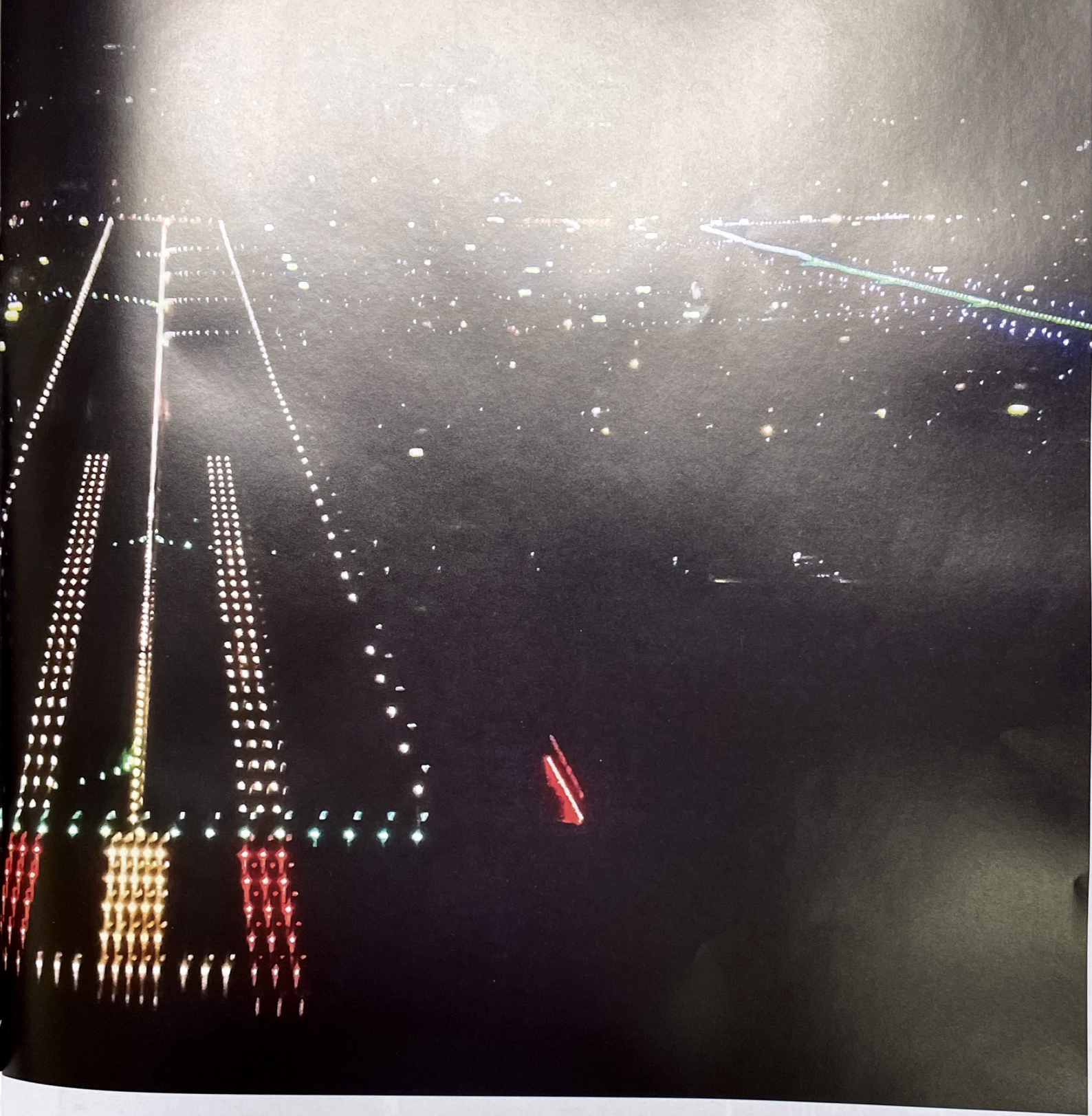
Glidepaths:
Do You Know Them All?
by Thomas Daniel

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You fly a Cirrus SR-series airplane. How many different types of glidepaths can you see on the Primary Flight Display (PFD)? A bonus question for all Cirrus SR experts, can you list them per avionics type? By glidepath, I mean any type of vertical guidance displayed on the PFD.

The answer to the question depends on what type of avionics, primarily the Flight Management System (FMS, also called Navigator) your Cirrus has. Let's summarize it first and then provide details:

- One: Original non-WAAS GNS430
- Three: WAAS FMS (GNS430W, GTN650/750, GTN650/750Xi, IFD440/540/550) with Avidyne Entegra PFD
- Five: Cirrus Perspective
- Seven: Perspective+ or G500 TXi with GTN650Xi.

GNS430

If you fly a Cirrus with the original non-WAAS GNS430 and an Avidyne PFD Entegra or the classic non-glass 6-pack instrumentation, you will only get one, a glideslope on an ILS approach.

Quiz Question No. 1:
Is the ILS the only type of conventional (radio-based) approach where you get a glideslope?

Since you have a non-WAAS navigator, the RNAV approaches are limited to LNAV without a glidepath. Your navigator can't use baro-aiding to generate a glideslope based on the altimeter, so you are stuck at one.

Figure 1 (above) shows a glideslope on an Avidyne PFD. With Entegra EXP5000 PFD, glideslopes and glidepaths are depicted the same. You need to look at your navigator or the top left PFD data block to know which one it is.
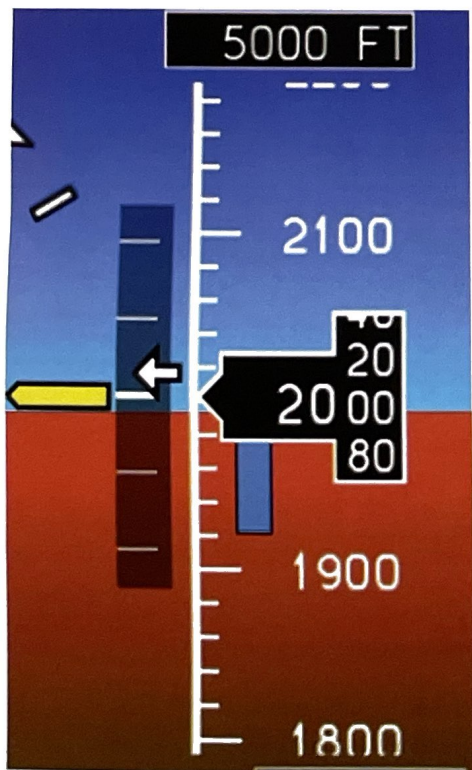

Figure 1: Glideslope on Avidyne PFB

Quiz Question No. 2:
What is the difference between a g[...] path?

WAAS

If you upgraded the GNS430 to WAAS w[...] [...]d that great deal or upgraded later to touch-screen naviga[...] [...]nin (GTN650/750, GTN650Xi/750Xi) or from Avidyne (IFD440/540/550) you can now enjoy LPV and LNAV/VNAV approaches, both requiring WAAS and both providing approved glidepaths. So how many are in the WAAS-equipped airplanes? Did you say two?

Not so fast! While glidepaths on LPV and LNAV/VNAV are approved, the navigator will also generate an advisory glidepath on LP and LNAV approaches, annunciating them as LP+V and LNAV+V. We just increased our count to three.

> *"An advisory glidepath is never referred to on approach charts, you must continue to use LP or LNAV MDA ... "*

What is an advisory glidepath? When in doubt, it is always best to ask the Federal Aviation Administration. Advisory Circular AC 90-107 has these words of wisdom: *Advisory Vertical Guidance – Vertical path deviation guidance indication that is generated by any means but is only an aid provided by some manufacturers to help pilots meet altitude restrictions. Advisory vertical guidance is an optional capability implemented at the manufacturer's discretion, not a requirement for positioning and navigation equipment.*

NOTE: It is the pilot's responsibility to use the barometric altimeter to ensure compliance with altitude restrictions, particularly during approach operations. Advisory vertical guidance is not approved vertical guidance like that found on approaches with lateral navigation (LNAV)/vertical navigation (VNAV), LPV or instrument landing system (ILS) lines of minima.

Approved Vertical Guidance – Actual vertical path deviation guidance indications generated by certified means for charted approach procedures that contain a U.S. Standard for Terminal Instrument Procedures (TERPS)-protected glidepath (e.g., approaches with LNAV/VNAV, LPV or ILS lines of minima).

Quiz Question No. 3:
Is advisory glidepath +V available on all LNAV and LP approaches?

An advisory glidepath is never referred to on approach charts, you must continue to use LP or LNAV MDA and these approaches remain non-precision.

The FAA is clear that advisory means what it says. The FMS simply draws a straight line from the runway to the FAF altitude and extends it. There is no obstacle protection and that is something you should be particularly careful of when descending below MDA.

Aren't you supposed to see the runway environment before descending below MDA? Yes, you are, but remember that even if you see PAPI lights, which is enough to keep going, it doesn't mean you will see that unlighted obstacle (i.e., a tree), if you fly at night or in one-mile visibility. In contrast, an approved glidepath is designed to avoid such obstacles and is flight-tested every 270 days.

As stated before, Avidyne PFDs depict all glidepaths and glideslopes the same (as shown in Figure 1), but Garmin Perspective uses different color coding for RNAV (GPS) and conventional (radio-based) approaches. Radio based (ILS) is always depicted in green (as seen in Figure 2, below), while GPS/RNAV is in Magenta (as seen in Figure 3, below).
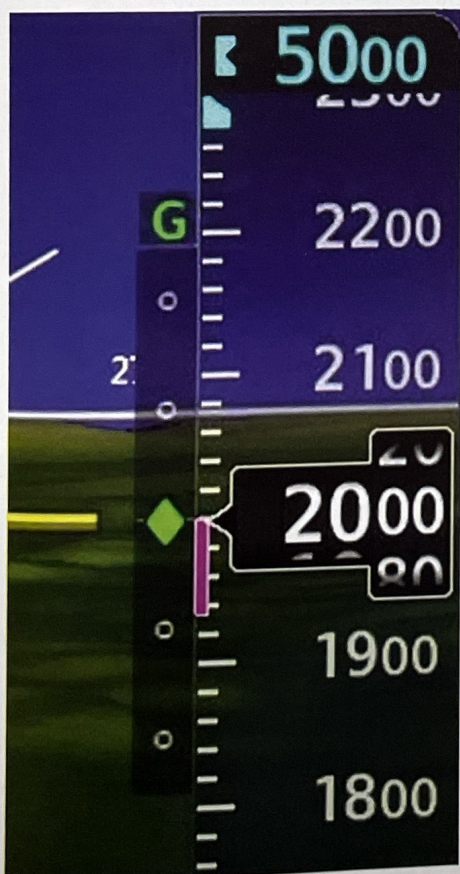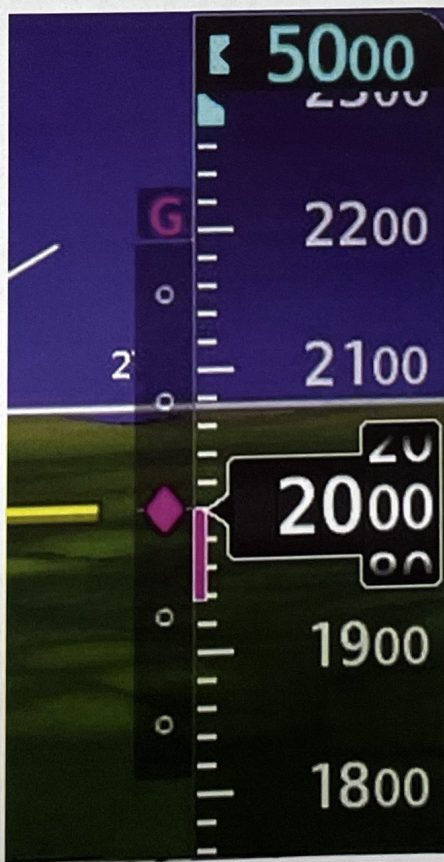
Figure 2: Perspective Glideslope

Figure 3: Perspective Glidepath

LNAV/VNAV

This type of approach is confusing to many pilots, particularly since they are rarely encountered when flying. To understand them, we must go back to when the original un-augmented GPS was introduced.

GPS allowed designers to create instrument approaches to many airports that couldn't afford expensive ground equipment required for ILS or LOC approaches, or were too far away from VOR or NDB transmitters. That was a great thing, except that it couldn't provide vertical guidance. Per the standard, 95% accuracy was only 400 feet vertically (120 feet horizontally), which was not enough. Although in practice, accuracy was typically much better, the standard numbers were insufficient. How were you to generate a glidepath then?

Smart people figured out that an altimeter could be used to generate a glidepath and avionics manufacturers obliged. This is called baro-aiding and it is the capability of avionics to generate and display a glidepath using an altimeter as the source. As we all know, an altimeter setting is required to correct for non-standard pressure. Thus, the baro-aided LNAV/VNAV approach is the only one where the glidepath is susceptible to errors due to the pilot setting the altimeter incorrectly.

> ## *"Perspective+ added a great feature called glideslope (on ILS) or glidepath (on RNAV) preview ... "*

Quiz Question No. 5:
When does a glidepath show on RNAV approaches?

Perspective+

Perspective+ added a great feature called glideslope (on ILS) or glidepath (on RNAV) preview, but I like to call it shadow glideslope or shadow glidepath, which brings the total to six or seven, depending on if you count them as one or two. Recall the approved glidepath on RNAV approaches shows on the VDI when the aircraft crosses the fix before the final; in other words, it shows when FAF becomes the active waypoint. Before that, you don't know if you are high or low on the approach, short of doing mental calculations. Shadow glidepath resolves that by displaying on the VDI much earlier, anytime you are close to the final approach course or established on the approach, which gives you great situational awareness for descents (see Figure 7, below).
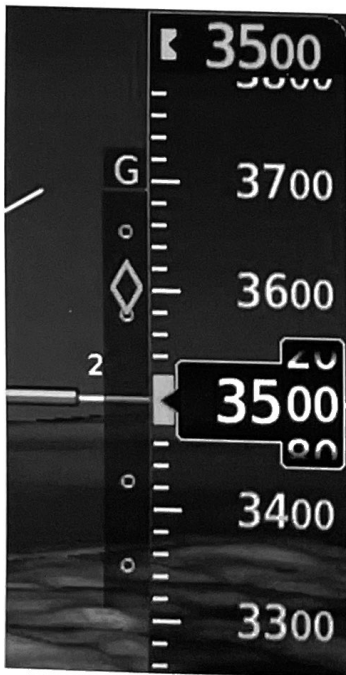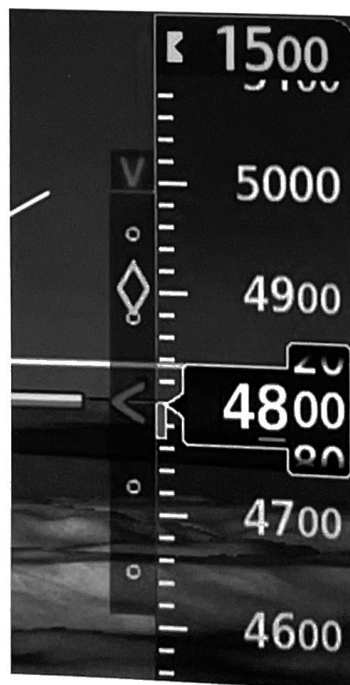

Figure 7: *Shadow Glidepath*

Figure 8: *GP and VPATH Converging*

The same �네ꞏ   ꞏn the G500TXi displays wi⁞ꞏ

What Garmin   glidepath, they took away wi⁞   navigation. In Perspective ai⁞.   . descending on VPATH levels of⁞ꞏ   ꞏⁿe final and waits for the glidepath. That required extra power changes, adding power when leveling off and reducing it again when capturing the glidepath. Garmin wanted to simplify that process and extended VNAV all the way to the final approach fix. With Perspective+, the airplane continues to descend on the VPATH while flying to the FAF, but at a gradient slower than the glidepath, so it gets closer and closer to the glidepath, which remains as a shadow glidepath (see example in Figure 8, below). When it is close enough, the shadow (hollow gray) glidepath switches to the approved (filled magenta) glidepath and the FMS seamlessly switches to it without leveling off. This looks great on paper, but the problem is that the switch from VPATH to glidepath is not predictable. You don't know exactly when it will happen, and until it happens, the glidepath remains a shadow. Since pilots know that autopilot doesn't couple to the shadow glidepath, our eyes remain glued to it, waiting for the switch, which may generate unnecessary fixation.

An even bigger problem occurs if you plan to capture the glidepath while flying to an intermediate fix, i.e., when the Final Approach Fix is not the active waypoint. You may be used to the fact that the airplane captures the shadow glidepath (or more precisely, the shadow glidepath turns approved and then is captured), but that will not happen. In this scenario, the airplane will fly through the shadow glidepath and will not capture it.

Lastly, earlier versions of Perspective+ were switching to the approved glidepath too early, when the airplane was still a dot below it, resulting in a momentarily pitch up and climb to intercept, certainly a disconcerting behavior when close to the final approach fix. This bug was fixed in the latest version of the software.

1. Is the ILS the ...
tional (radio-ba...
you will get glid...

While relatively ra... ...ere are also LDA approaches with glideslope. Recall that the difference between LOC and LDA is that LOC must align within 3° to the runway. If it is more, it is called LDA. LDA/GS is an ILS that is not aligned (more than 3° difference) with the runway. It is a precision approach with decision altitude. Examples include LDA/GS 22 AMA and LDA/GS 25 EGE, but there are more.

2. What is the difference between a glideslope and glidepath?

A glideslope is a radio signal present on ILS approaches, generated by a ground-based transmitter and received by the airplane navigational radio. A glidepath is computed by the airplane navigator based on the GPS altitude information. Both are displayed on the PFD in the same (Avidyne Entegra) or different (Cirrus Perspective) ways.

3. Is advisory glidepath +V available on all LNAV and LP approaches?

WAAS must be available, and the approach must have a straight in minima for +V to be generated. If there are only circling minima, it will not be available. Look at RNAV A and B at MEV for examples.

4. Why do you rarely get to fly LNAV/VNAV approaches?

Pilots cannot choose which approach to fly, and FMS will always choose LPV minima over LNAV/VNAV if they exist. There are only two cases when you will see LNAV/VNAV approach selected:

th... ...
which is the c...

Note that the most common cause for WAAS unavailability is that an instructor switched it off for training purposes.

5. When does the glidepath show on RNAV approaches?

Glidepath shows when the final approach fix becomes the active waypoint, which typically happens when you cross the fix before FAF.

Summary

Again to summarize, the number of glidepaths you can see on your PFD:

1. Original non-WAAS GNS430 – one.

- Glideslope on ILS or LDA/GS approaches

2. WAAS FMS (GNS430W, GTN650/750, GTN650/750Xi, IFD440/540/550) – three.

- Glidepath on LPV and LNAV/VNAV approaches
- Advisory glidepath on LP+V and LNAV+V approaches

3. Perspective – five.

- Baro-aided glidepath on LNAV/VNAV approaches
- VNAV

4. Perspective+ - seven

- Shadow glidepath
- Shadow glideslope

Did you get them all correct? ⊕