VFR Without GPS
Mastering Visual Navigation and Dead Reckoning

Pilot tips & tricks

1. Introduction

Flying without GPS is more than a nostalgic throwback—it's a powerful way to strengthen your fundamental pilot skills. This bulletin revisits **the core techniques** of visual navigation, focusing on two pillars of old-school VFR flying: visual navigation and **dead reckoning**. Whether you're training for a check ride or just curious to test your skills, understanding these principles will make you a better, more confident pilot.

2. Pilotage – Navigating by what you see

Pilotage is the technique of navigating using **visible landmarks** on the ground. It requires a good preflight briefing, spatial awareness, and constant cross-checking between your chart and the outside world.

What to Look for:

- **Linear features**: rivers, highways, railroads, ridgelines
- **Unique landmarks**: large buildings, quarries, lakes with distinctive shapes
- **Terrain contrast**: forest boundaries, elevation changes, valleys

Best Practices:

- Choose **checkpoints** every 5–10 NM apart
- Prefer landmarks **within 2 NM** of your intended route
- Avoid relying on small, ambiguous features (isolated trees, minor roads)

3. DR– Navigating by Time, Speed, Heading

Dead reckoning is the process of estimating your position using **time, speed, heading, and distance**. It's a core skill for GPS-free VFR flying and follows three key steps:

3. A. 3.1 Step 1 – Preflight Planning

- Draw your route on a VFR chart
- Measure **true course**, distance and estimate **groundspeed** based on aircraft performance
- Calculate **ETE (Estimated Time Enroute)** for each leg
- Build your **navigation log**: checkpoint names, headings, distances, ETEs, and planned altitudes (see Annex A.)

3. B. 3.2 Step 2 – Day-of-Flight Updates

- Check actual **wind aloft** and adjust your **Wind Correction Angle (WCA)**
- Apply **magnetic variation** and WCA to calculate **magnetic heading**
- Recalculate **groundspeed** and adjust ETEs

- Review current **airspace activity** (e.g. danger zones, NOTAMs)

3. C.   3.3 Step 3 – In-Flight Monitoring

- Time each leg with a stopwatch
- At each checkpoint, compare **actual vs planned time**
- If you're early or late, recalculate the **ETA for the next waypoint**
- Make small heading adjustments if needed and cross-check with visual references

4.   Reading the Chart-How to Navigate Visually

Successful visual navigation begins on the ground — with the ICAO VFR chart. It holds all the information needed to plan and execute a route without the help of a GPS or radio aid. In this section, we'll look at how to extract relevant visual references and how to identify what you see from the air.

4. A.   How to Identify Towns and Villages

When looking at a VFR chart, towns and villages are represented by **yellow or orange shaded areas**, scaled roughly by size and layout. Some tips for matching chart data to real-world views:

- **Shape matters**: Focus on the **outline** of the town – U-shaped lakeside towns, grid layouts, clustered villages with rail junctions, etc.
- **Relative position**: Use the location **relative to terrain** (on a river bend, between two hills, on a ridge).
- **Surroundings**: Identify **adjacent features** such as forests, lakes, power lines, roads, or railways for confirmation.
- **Avoid over-relying on small settlements**: They may be hard to see in flight, especially in haze or low light.

4. B.   Choosing Good Visual Checkpoints

Not all chart features make good checkpoints. When navigating without GPS, choose landmarks that are:

- **Large** and **unambiguous**: Lakes, highways, major rivers, large towns
- **Linear**: Rivers, roads, railways are ideal for verifying drift and heading
- **Visible from a distance**: Open terrain, sharp terrain edges, mountain passes
- **Consistent with your route**: Stay within 1–2 NM of your track for easy visual confirmation

4. C.   Combining Features for Confidence

Rather than relying on a single landmark, use **a combination of features** to confirm your position. For example:

- A town on the edge of a lake with a highway exit just south of it
- A river that curves sharply around a hill, with a rail line crossing
- A road junction near a bridge and just below a ridgeline

This technique reduces the chance of **misidentifying your location**, especially in areas with similar terrain.

4. D.   Vertical Navigation and Terrain Awareness

ICAO charts also show:

- **Terrain elevation** via contour lines and color shading
- **Obstacles** (e.g., towers, wind turbines) marked with height in feet AMSL and AGL
- **Maximum Elevation Figures (MEFs)** for each quadrant

Always plan to fly **with generous terrain clearance**, especially when using only visual navigation. This is critical in mountainous regions like Switzerland. Pilots must also maintain a safe vertical distance from the ground, typically at least 500 feet above the highest obstacle within 5 nautical miles of the intended track.

4. E.   Airspace Awareness

Remember, navigation also includes **avoiding controlled or restricted airspace**:

- Use the chart to identify the base and top of airspace volumes (TMA, CTR, restricted zones).
- Plan your route to **remain outside** or **below/above** these areas unless you have clearance.
- Crosscheck waypoints with airspace boundaries to stay legal and safe.
- Always fly minimum 100ft away from the boundaries of the "forbidden" airspace as a safety margin

5.   Practical Scenario

Let's imagine the following situation:

You're tasked with flying a VFR cross-country flight **from Grenchen (LSZG) to Lausanne-La Blécherette (LSGL)**. You are not allowed to use GPS, moving maps, or position overlays. Your only navigation tools are a **paper VFR chart, stopwatch, magnetic compass, and your eyes**.

This is a **50 NM route**, crossing diverse Swiss terrain: lowland plains, lakes, and built-up areas. You will need to avoid controlled airspace, stay clear of military zones, and keep visual with key terrain features throughout.

- Annex A. B.

- [Aeronautical Chart ICAO CH](#) ([LSZG–LSGL](#))

- [VFR Charts](#): vacc.ch → airports and charts → select airport (e.g. LSZG) → charts VFR

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Annex A.

VFR Navigation Log – LSZG to LSGL

Leg	From → To	Distance (NM)	True CRS	WCA	Mag. Heading	ETE	RTE	Landmark / TMA; CTR
1	LSZG → Lake Biel (Nidau)	9	255°	+3°	**256°**	5:30		South end of Lake Biel
2	Nidau → Murten	13	230°	+2°	**228°**	7:50		Murten town & lake
3	Murten → Fribourg (A12/Sarine)	12	225°	+2°	**223°**	7:15		Highway/river crossing/ TMA PAY
4	Fribourg → Romont	9	225°	+1°	**224°**	5:30		Hilltop town with castle / FIR GVA
5	Romont → Lausanne (entry point)	11	210°	+1°	**209°**	6:30		A9 motorway east of LSGL
6	Entry → LSGL Final	3	245°	0°	**245°**	2:00		Final join and landing

Cruising Altitude: 4500 ft. ASML

Aircraft: Single-engine piston (e.g., C172)

Total distance: ~57 NM

Estimated total time: ~35 minutes (without wind)

Notes:

- **WCA** (Wind Correction Angle) assumes light wind from NE (you can adjust for actual wind).
- Each leg should be timed with a stopwatch.
- Landmarks selected for **high visibility and ease of recognition**.
- You should draw this route on a **sectional VFR chart** and highlight each checkpoint clearly.

Annex B.

LSZG – LSGL Maps