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COVER PHOTO
COPA Members Steve "Axel" Foley and Jack Oswald's 2019 SR22T on the ramp at Sedona, Arizona.

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Is Mountain Flying Really So Dangerous? *Or is it "Just" Human Error?*

by Michael Hochenrieder

THE YEAR 2019 WAS A SAD one for mountain flying in the Austrian Alps. There were two fatal Cirrus SR22 accidents, resulting in five fatalities. As a local CSIP based in Salzburg, Austria, I've supported the accident investigations and analysis from the national SUB. The SUB (Sicherheitsuntersuchungsstelle des Bundes or the Federal Safety Investigation Authority) is responsible for the investigation of accidents and serious incidents involving civil aircraft in Austria, and is similar to the National Transportation Safety Board (NTSB) in the U.S.

In both crashes the Cirrus Perspective and/or RDM logs (Recoverable Data Module, similar to a flight data recorder in the tail of every Cirrus Perspective airplane) provided several valuable insights that were the basis for the accident analysis, as well as lessons to help prevent these kinds of accidents in the future.

The following information is based on preliminary data – the final reports have not yet been published – and are only my personal opinion as a CSIP/mountain flying instructor/examiner. Based on the facts you should form your own opinion.

I feel that human factors, especially Aeronautical Decision Making (ADM) were the root cause in both accidents. Mode Confusion and Automation Over-reliance were contributing factors in the second accident.

VFR Mountain Accident

On July 18, 2019, a Cirrus SR22 G3 was on a flight from Italy to Germany. The aircraft collided with terrain at an altitude estimated at 7,500 feet MSL. The post-crash fire destroyed the wreckage. The pilot and two passengers were killed.

The weather was VMC with light winds, the fully airworthy aircraft had no mechanical issues. There was sufficient fuel on board.

After passing the Innsbruck CTR (control zone), the pilot had left the intended flight path to the north with a climbing left turn towards Wetterstein mountains/Leutascher Platt at 90 to 100% power.

When the pilot recognized he would not be able to overfly the narrow valley pass with maximum power, he started another left U-turn/box canyon turn.[1] The RDM recorded the first stall warning alert at a roll angle of 42 degrees at 95 knots with no rate of climb/descent. At this point the aircraft was at about 300 feet AGL.

Figure 1: Final Flight Track (Source: SUB)

Weight	Bank Angle	STALL SPEEDS					
		Flaps 0% Full Up		Flaps 50%		Flaps 100% Full Down	
LB	Deg	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
3400 Most FWD CG	0	73	70	66	64	62	60
	15	74	71	67	65	64	61
	30	76	75	71	69	66	64
	45	83	83	77	76	72	71
	60	99	99	90	90	84	84
3400 Most AFT CG	0	72	69	65	63	60	58
	15	73	70	66	64	61	59
	30	76	74	69	67	63	62
	45	82	82	76	75	69	69
	60	98	98	89	89	82	82

Figure 2: SR22 Stall Characteristics

The next eight seconds included more stall warnings with a sink rate of up to 3,000 feet/minute.

The last data point was recorded with the following key points:

- Engine power at 90 to 100%
- Pitch angle was 18 degrees nose-down
- Roll angle was 75 degrees to the left
- Ground speed was 112 knots; air speed was 106 knots
- Rate of descent of 2,944 feet/minute

According to the Cirrus Aircraft Flight Manual (AFM) and the laws of aerodynamics, the stall speed rises rapidly with an increased bank angle (see Figure 2, above).

This was another classic stall accident in a box canyon turn.

The commercial pilot was highly experienced with about 8,600 total hours, a flight instructor rating (non CSIP),

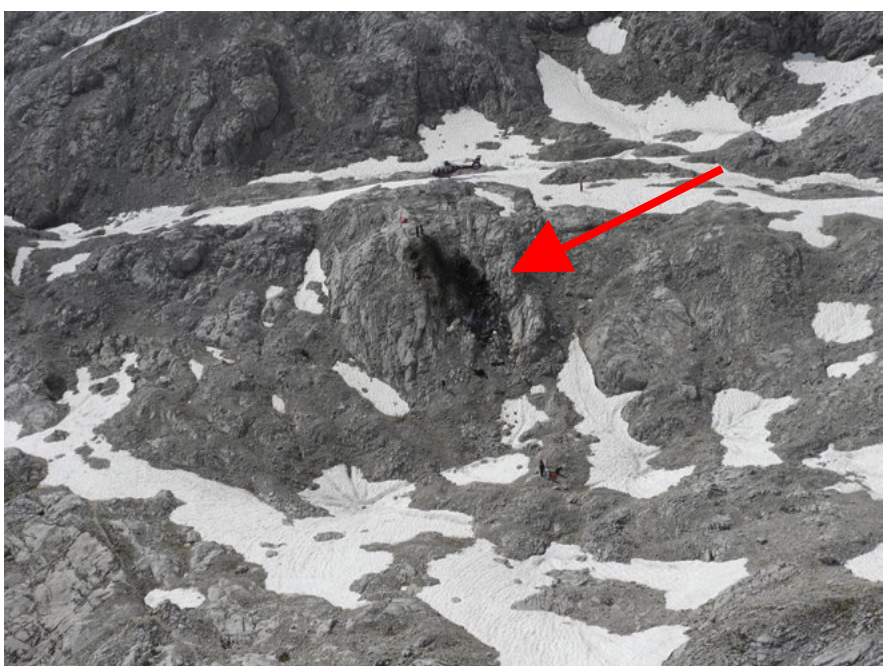


Figure 3: Burned area marks where the SR22 wreckage was located – at approximately 7,500 feet.

Figure 4: SR22T wreckage after CFIT.

European aerobatics rating and a type rating for a Pilatus PC12. Based on his logbook entries he had about 150 hours experience in an SR22.

The key question: Why did the pilot leave his intended (safe) route and fly into a narrow box canyon?

Unfortunately, this question will never be answered.

IFR Mountain Accident

On December 21, 2019, the pilot, with his young family members, planned to fly his Cirrus SR22T from his home airfield in Germany to Zell am See, Austria for the Christmas holiday.

The flight started under visual flight rules, and shortly after takeoff continued under instrument flight rules. The pilot flew the published RNP-A approach. After the "Missed Approach Point," he continued, under visual flight rules, in bad weather with both a low ceiling and visibility while in mountainous terrain! Passing the airfield in an easterly direction, the airplane crashed in a wooded area in the mountains.

The pilot had a total of about 650 hours and an estimated 530 hours in type. Between Sept. 2015 and Dec. 2019, he had flown (including the accident flight) to the mountainous airfield Zell am See 11 times.

The official general aviation forecast reported for the accident time was:

- M = Marginal conditions with low clouds and
- X = closed (for VFR flights)

The pilot was aware of the bad weather at the destination airport. The airplane was equipped with a satellite weather system (ADL Connect – Inflight data link weather, similar to XM in the U.S.). The latest METAR the pilot received before the crash (based on log data from the provider) was:

METAR LOWZ 211320Z AUTO 26005KT 4600 -SN OVC004 01/M00=

At the same time, the pilot was informed by Innsbruck RADAR about the conditions:

Innsbruck RADAR: *For Information: The weather in Zell am See is overcast 400ft above ground, visibility 4,700 Meters, light snow.*

DXXXX: *roger. We'd like to try the approach and if not possible, we are turning back to NANIT, … and then to Salzburg.*

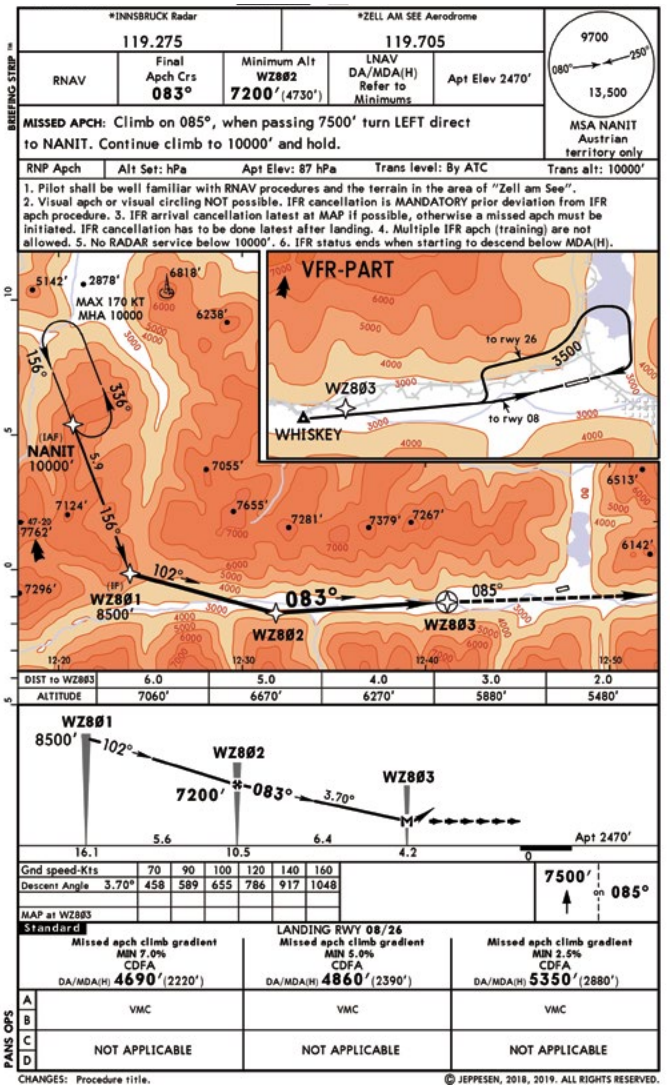


Figure 5a: RNP-A Approach LOWZ (copyright Jeppesen)

To understand the complexity and challenge of this procedure, we reviewed the approach plate (see Figure 5a above):

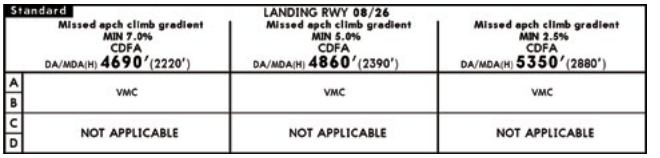


Figure 5b: Minimums

If you look at the minimums (even with a minimum climb gradient of 7% in the missed approach) the missed approach procedure begins at 2,220 feet AGL!

Remember, the reported ceiling was OVC004!

It's hard to understand why the pilot "busted" the minimums by more than 1,500 feet in overcast 400-foot conditions.

My personal experience as an instrument flight instructor and Designated Pilot Examiner (DPE) is that pilots often do not understand that the RNP-A approach in Zell am See (LOWZ) is NOT a full instrument approach – it's just a **cloud breaking procedure** with a mandatory VFR part associated with high circling minimums (see the note in minimums section, Figure 5b).

For visualization purposes at the recent COPA University CPPP at Salzburg, Austria, which focused on mountain flying, I created a 3D video based on the accident log data.

Below is the cockpit view at the MAP (WZ803) in VMC (Figure 6), yet the pilot decided to continue the descent to an estimated altitude of 3,070 feet and crashed into the mountain at 11 o'clock.

Mode Confusion/Automation Overreliance

During our review of the Cirrus Perspective log data we discovered an additional interesting fact: **"Button Mashing."** From the IAF (NANIT) to the crash site (estimated 17 NM) the pilot changed the vertical navigation mode 17 times! The

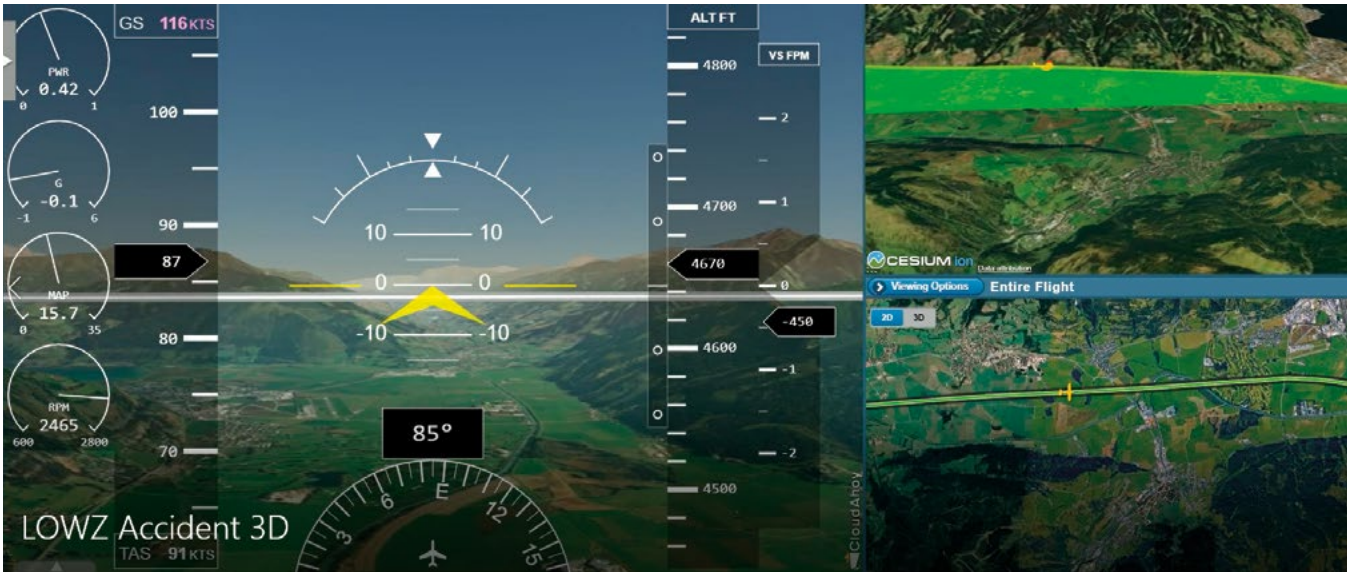


Figure 6: Cockpit visualization of the instrument procedure.

E1 %Pwr	AFCS ON	Lat (RollV)	Vert (PitchV)
60%	1	GPS	ALT
60% → 44%	1	GPS	VS: - 900 fpm
44% → 22%	1	GPSa	ALT
22%	1	GPSa	VS: - 200 fpm
22%	1	GPSa	PIT
22% → 80%	1	GPSa	ALT
80% → 60%			IAS
60% → 30%			ALT
30% → 24%			VS: - 1.000 fpm
24%			VPTH: (est. – 600 fpm)
24% → 40%			ALT
40% → 32%	1	GPSa	VS: -1.000 fpm
32%	1	GPSa	VPTH: (est. – 600 fpm)
32% → 11% → 30%	1	GPSa	VS: -1.000 fpm
30% → 40%	1	GPSa	ALT
40% → 3%	1	GPSa	VS: -1.200 fpm
3%	0	NONE	NONE

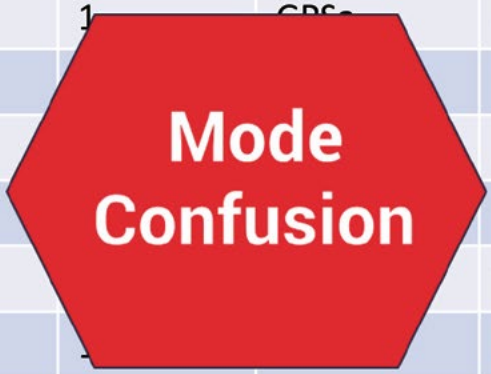


Figure 7: Mode changes during the procedure.

table (Figure 7 above) summarizes the percentage power settings/changes, the AFCS status (Autopilot 1=ON or 0=OFF) as well as the lateral (GPS or GPSa) and vertical input.

Please ask yourself: Is this a stabilized approach according to the criteria specified in the iFOM (chapter 2, section 19)?

One possibility is that at the FAF (WZ802) the pilot expected to receive a vertical guidance similar to a glidepath on a LPV approach or at least an "advisory" glidepath for an LNAV+V.

Fact: On these types of procedures (just as on circling only approaches) **there's no vertical guidance** provided – not even a LNAV+V. According to a Garmin support engineer, "The database is actually setting the advisory vertical (+V) flag for many procedures including this one, but the avionics suppresses that functionality." A typical reason is "**that the approach does not align with a specific runway.**" Details can be found in the definition of Circling-only Procedures.[2]

Question: What mode should we use for the descent phase from FAF – MAPt?

Answer: VS (Vertical Speed) with the corresponding sink rate based on the ground speed.

Approximately two months after the fatal crash in Zell am See, the FAA published a recommended Safety Fact Sheet with a very good summary: CFIT/Automation Overreliance (see Figure 8).[3]

Some tips from the FAA's Aviation fact sheet for a successful pilot/automation relationship:

- Understand how your automation works, and how it behaves when it isn't working.
- Understand where your automation is getting its information and how it will respond if that information is missing or flawed.
- Know all the ways to quickly disconnect your automation and revert to hand flying.

General Aviation
Joint Steering Committee
Safety Enhancement Topic

FAA Aviation Safety

CFIT/Automation Overreliance

Technological advances in situational awareness have dramatically reduced the number of GA Controlled Flight Into Terrain (CFIT) accidents. However, the General Aviation Joint Steering Committee (GAJSC) has found that reliance on automation is a precursor to CFIT events. Awareness of automation limitations and pilot proficiency in flying with and without automation are key to safe flight operations.

Figure 8: Refer to the FAA Safety Fact Sheet regarding CFIT/Automation Overreliance.

- Practice hand flying regularly to keep your skill and confidence levels high.

Conclusions

What are your personal lessons learned based on these two fatal accidents in the Austrian Alps?

If you plan to fly in the mountains, here are two questions you need to ask yourself:

Have I recently participated in either an initial or refresher mountain flying training with an experienced mountain instructor/CSIP?

Am I proficient in mountain flying techniques, e.g., box canyon turns or steep turns with bank angles greater than 45 degrees and the resulting stall characteristics?

If the answer to either question is "no," you should rethink making the flight.

Some additional questions:

Do you always plan your mountain flight with escape routes in case of bad weather?

How do you prepare complex mountain instrument procedures? (Best Practice: Use the Cirrus/Garmin Perspective PC trainer with the latest database and "chair fly" the procedure at home with the corresponding chart so you know what to expect e.g., no vertical guidance on an approach with only circling minimums.)

What's your personal antidote against hazardous attitudes?

- "Get-there-itis"
- "If I just drop below the minimum, I guess I'll see the runway…"

At COPA University, we've introduced two new and updated courses which will be presented at future CPPPs:

- Automation Management – what to expect and what NOT to expect
- Mountain Flying – Tips & Techniques (to be presented only on special CPPPs in Colorado in the U.S. and Austria in Europe)

Any kind of mountain flying in a Cirrus SR2x, a Piper Super-Cub or a helicopter is a beautiful experience – if you are proficient and use thorough ADM. ⊕

Special thanks to:

Austrian SUB accident investigators Mr. Rogl and Mr. Ringl, who did a fabulous job on the comprehensive analysis.

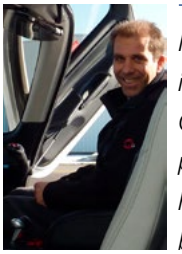
Cirrus Air Safety department's Mr. Miller, who supported in the extraction of the RDM logs.

Notes:

[1] See https://www.mountainflying.com/Pages/mountain-flying/box_canyon_turn.html for further explanation.

[2] FAA Instrument Procedure Handbook (IPH), https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/instrument_procedures_handbook/media/FAA-H-8083-16B_Chapter_4.pdf, Page 4-11

[3] https://www.faa.gov/news/safety_briefing/2019/media/SE_Topic_19-11.pdf



Michael Hochenrieder is an independent CSIP, designated pilot examiner, and helicopter pilot based in Salzburg, Austria. As a CPPP flight and ground instructor in Europe and the U.S., he specializes in TAA (Technical Advanced Aircraft) instruction, in particular instrument procedures with Cirrus Perspective/Perspective+. He also teaches mountain flying in Cirrus aircraft.