



Australian Government
Australian Transport Safety Bureau

Loss of control and collision with terrain involving Cirrus SR22, VH-PDC

Orange Airport, New South Wales | 15 May 2018



Investigation

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Addendum

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Safety summary

What happened

On 15 May 2018, at 1903 Eastern Standard Time, a Cirrus SR22 aircraft, registered VH-PDC, collided with terrain at Orange Airport, New South Wales. The accident was a night training flight with one pilot (aircraft owner) and one flight instructor on board. The pilot and instructor were seriously injured and the aircraft destroyed.

What the ATSB found

The ATSB found that the pilot, who was conducting his first night training flight, likely became spatially disorientated during a go-around manoeuvre, which resulted in a loss of control at low level and collision with terrain.

The flight instructor did not intervene to take control of the aircraft during the go-around manoeuvre, because she was not aware the pilot had become spatially disorientated and was accustomed to directing the pilot to correct control problems. Inconsistent with Civil Aviation Safety Authority guidance, the instructor, who had previously instructed the pilot for his private instrument rating, did not provide a night flying demonstration before directing the pilot around the circuit.

Safety message

It is important for flight instructors to provide a demonstration when introducing a pilot to a new flight sequence or new flight environment. Time spent demonstrating the key points of a new sequence or environment will usually improve the learning process by ensuring that the development of a new skill is supported and preceded by knowledge and understanding from experience.

The flight instructor reported that for the delivery of future initial night flying training, she would conduct either a separate session of daytime flying training circuits prior to night, or deliver the training as day-into-night circuit training. She also commented that, prior to teaching night flying, flying training organisations should consider conducting refresher training in unusual attitude recoveries, irrespective of a pilot's level of experience and qualifications.

The occurrence

On 15 May 2018, at 1903 Eastern Standard Time,¹ a Cirrus SR22 aircraft, registered VH-PDC, collided with terrain at Orange Airport, New South Wales. The accident was a night training flight with one pilot (aircraft owner) and one flight instructor on board. The pilot and instructor were seriously injured and the aircraft destroyed.

The pilot held a private instrument rating and the accident flight was the pilot's first training flight for a night endorsement to be added to his rating.² The instructor arrived at the hangar in the evening, just as the pilot was completing his pre-flight inspection of the aircraft. They completed the inspection together and then the instructor delivered a night flying brief to the pilot. The briefing included the physiological effects of the night environment, procedural differences for the night circuit, and the instrument and visual sections of the night circuit, which included the need to transition onto instruments on rotation during take-off.

The pilot and instructor boarded the aircraft and completed all the checklist items on the multi-function display (MFD). The wind appeared to be light and variable and they selected runway 11 for the circuits. The pilot activated the runway lighting while taxiing,³ which also provided precision approach path indicator (PAPI) lighting.⁴

The instructor directed⁵ the pilot throughout the first touch-and-go⁶ circuit to runway 11, which she considered was flown to a good standard with the pilot responding to her direction. On the second circuit, at about 500 ft above ground level on approach to land, the pilot and instructor noted the approach was too steep. The pilot, with direction from the instructor, corrected the approach and they both observed two-white and two-red PAPI lights on short final approach, which indicated they were on the correct approach path. The pilot flared the aircraft a 'little high' for the touchdown, and the aircraft bounced twice. The pilot elected to go-around and applied full power before touching down again.

When full power was applied, the aircraft pitched⁷ up. As the pilot was attempting to transition his scan onto the instruments, the instructor, whose attention was on the attitude indicator,⁸ directed him repeatedly to level the wings—'wings level'. The pilot observed the runway lights disappear off to the right and felt the aircraft was in a roll⁹ as he was trying to focus his attention on the attitude indicator.¹⁰ Following a review of the ATSB's draft investigation report, the pilot also reported that he manipulated the flight controls in an attempt to recover the aircraft. Shortly after, the aircraft collided with the ground, struck a fence and came to rest inverted.

¹ Eastern Standard Time (EST): Coordinated Universal Time (UTC) + 10 hours.

² A pilot who has a private instrument rating is authorised to operate at night under the instrument flight rules only if that pilot holds a night private instrument endorsement.

³ Pilot activated lighting (PAL) is activated by a pilot keying a series of transmissions, within a specified timeframe, on a specified radio frequency.

⁴ PAPI is a visual aid that provides pilots with guidance on acquiring and maintaining the correct approach path to a runway. The system consists of four side-by-side lights positioned next to the runway. When the aircraft is on the desired approach path (3°), two red and two white lights will be visible. More than two red lights indicates the aircraft is low on approach, and more than two white lights indicates the aircraft is high.

⁵ Airborne instruction is based on a building block approach using *demonstrate*, *direct* then *monitor*. The instructor flies the sequence in *demonstrate*, provides verbal commands to the student in *direct* and observes the student's progress in *monitor*.

⁶ A procedure whereby an aircraft lands and takes off without coming to a stop.

⁷ Pitching: the motion of an aircraft about its lateral (wingtip-to-wingtip) axis. Increased thrust over the tailplane will increase the tailplane down force and pitch the nose upward.

⁸ Attitude indicator is a primary flight instrument, which displays the aircraft pitch and roll against an artificial horizon.

⁹ Rolling: the motion of an aircraft about its longitudinal axis.

¹⁰ The Cirrus SR22 aircraft's propeller rotates clockwise, as viewed from the pilot's seat. Therefore, an increase in power will increase the engine torque reaction and propeller slipstream. Without pilot input, the natural response from the aircraft is to roll and yaw (motion of an aircraft about its normal axis) to the left.

The pilot reported that he ‘kicked the pilot’s door window out’ to exit the aircraft, at which stage the wings were alight and a grass fire had started.¹¹ He then pulled the instructor out of the wreckage, who had lost consciousness after becoming disorientated while looking for the emergency egress hammer.¹² Emergency services located at the airport immediately responded to the accident. Figure 1 shows the wreckage site with reference to runway 11. Weather conditions were not considered a contributing factor to the accident.

Figure 1: VH-PDC wreckage



Source: ATSB

¹¹ The fence was electrified, but it was not determined if the fence or the engine was the ignition source for the fire.

¹² An eight-ounce ball-peen type hammer is located in the centre armrest. If the cabin doors are jammed or inoperable, the hammer may be used to break through the acrylic windows.

Context

Pilot information

The flight instructor held a valid Commercial Pilot Licence (Aeroplane), a Grade 1 flight instructor rating, an instrument rating and a night visual flight rules rating. She had a total flying experience of about 4,200 hours and last completed a flight review on 3 December 2017.

The pilot held a valid Private Pilot Licence (Aeroplane) and a private instrument flight rules rating. He last completed a flight review on 11 March 2017 (private instrument rating), had accrued about 500 hours on Cirrus aircraft, and about 50 hours of instrument flight time. The pilot had conducted the majority of his training and subsequent flying from Orange Airport, where his aircraft had been hangared.

Closed-circuit television footage

Closed-circuit television footage from Orange Airport depicted the aircraft rolling left at a low height above runway 11 before impacting the ground on the north-east side of the runway at 1903. A small fire ensued after impact, followed by deflagration of the fuel vapour about 7 seconds later. About 9 minutes later, the CAPS¹³ rocket fired. Figures 2, 3 and 4 depict the initial roll of the aircraft, deflagration of the aircraft fuel vapour and firing of the CAPS rocket.

Figure 2: VH-PDC in left roll



Source: Orange City Council, annotated by the ATSB

Figure 3: Deflagration of fuel vapour



Source: Orange City Council

¹³ The aircraft was fitted with the Cirrus Airframe Parachute System (CAPS), which is a ballistic parachute recovery system. When the pilot activates the CAPS system, a rocket in the aft fuselage ignites and dislodges the CAPS cover. The rocket then extracts a deployment bag containing the parachute from the aircraft.

Figure 4: CAPS rocket



Source: Orange City Council, annotated by the ATSB

Aircraft information

Electronic stability and protection

Before take-off, the pilot checked the aircraft's autopilot and then switched it off. When the autopilot is switched off, the aircraft's electronic stability and protection (ESP) system is operational. The ESP system automatically activates the autopilot servos to recover the aircraft from excessive roll and pitch attitudes.

The ESP roll protection activates at 45° roll angle, reaches a maximum stick force at 50°, and disengages when the roll angle reduces to 30°. The ESP pitch protection engages at 17.5° nose up, reaches a maximum stick force at 22.5° and disengages at 12.5°. Although the ESP uses the autopilot servos to drive the controls, the pilot retains the ability to override the system.

Recorded data

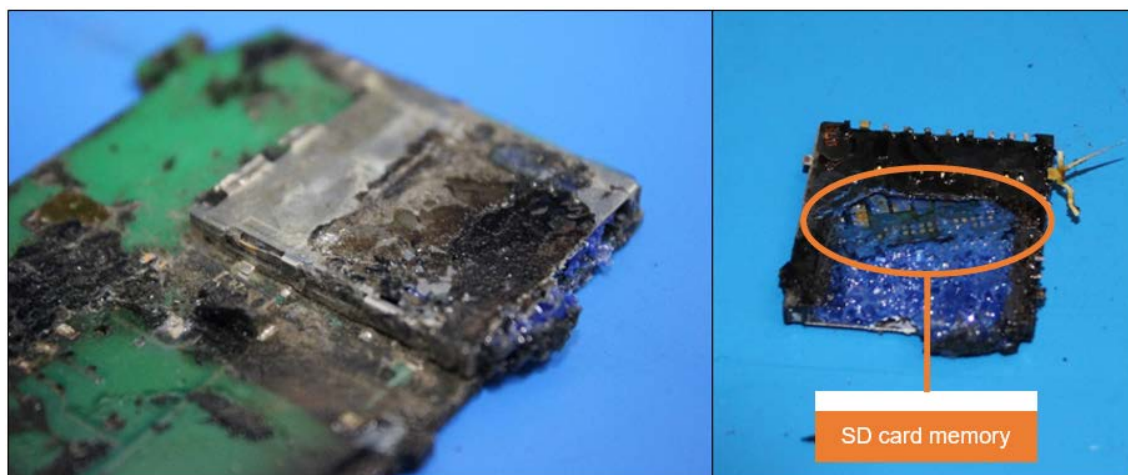
VH-PDC carried a Garmin G1000 avionics package, and a Recoverable Data Module (RDM). The G1000 is capable of recording various parameters to a secure digital (SD) card, installed on the upper slot of the MFD. The same information is recorded to the RDM, which is an impact and fire resistant unit,¹⁴ installed on the vertical fin spar. The RDM and MFD modules were removed from the aircraft for examination by the ATSB.

The RDM was recovered from the severely fire damaged fin. The rear portion of the module was exposed to a high temperature and showed external heat damage. Disassembly of the crash hardened enclosure to access the data storage components revealed extensive fire damage to the memory devices. No data was recovered from this device.

Initial observations of the MFD SD card slots revealed they were substantially fire damaged and retained two SD cards; the top slot contained the data logging card, the bottom slot contained the Garmin database card. To access the cards, the MFD was disassembled, and the circuit board holding the two cards was removed. The data logging card was found to be substantially damaged (Figure 5). The encapsulated memory device was removed from the data logging card and cleaned. The data logs were then extracted with a modified SD card reader. A total of 241 flight logs were recovered, including the accident flight (Figure 6).

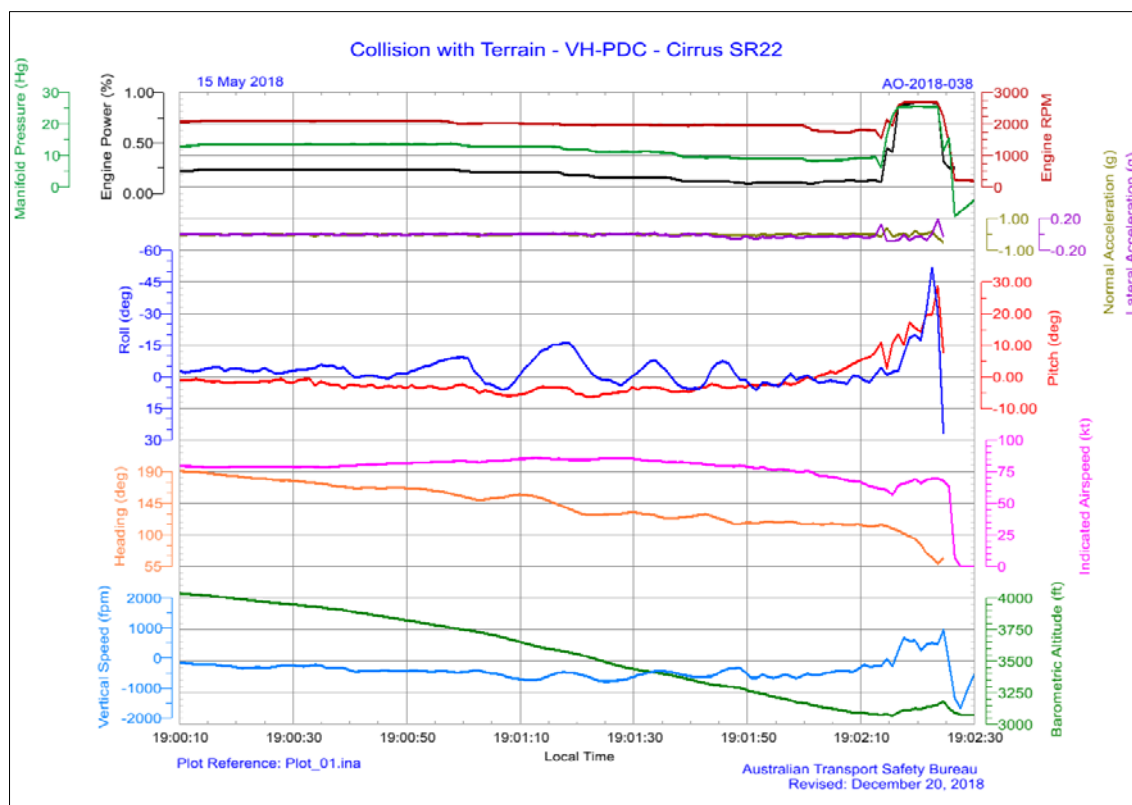
¹⁴ As advertised by the manufacturer - Heads Up Technologies.

Figure 5: Data logging SD card



Left: Removed MFD slot with data logging SD card. Right: removed data logging card with card memory identified.
Source: ATSB

Figure 6: Recovered accident flight data



Source: ATSB

The recovered flight data indicated that after touchdown, power was initially increased to about 45 per cent (19:02:15) and a slight left roll initiated. Power was then advanced to about 90 per cent (19:02:18) and the left roll developed to a peak value of -52° (19:02:23) with a pitch attitude of $+20^{\circ}$ (nose-up)¹⁵ and airspeed varying from 56–69 kt.¹⁶ The pitch attitude then increased to a

¹⁵ The nose-up pitch attitude on take-off and the first touch-and-go circuit was $7-9^{\circ}$. When the aircraft is trimmed for a low power and low airspeed approach, an increase in thrust over the tailplane will increase the down force produced by the tailplane, pitching the tailplane down and the nose up.

¹⁶ An approximate stall speed of 73 kt was calculated. Conditions were: full flap, full fuel, two occupants, 20° pitch-up, 52° roll, density altitude 2,600 ft and idle power. The use of high power would reduce the stall speed.

peak value of +29° before lowering to +7° as the aircraft rolled right to a peak value of +27° at a height of about 100 ft above the runway (19:02:25).

The aircraft collided with the ground followed by the airport boundary fence and came to rest inverted during the period 19:02:26–30.¹⁷ The final track at initial impact was about 60° left of the runway centreline. During the accident sequence, the rate of heading change to the left developed commensurate with the angle of left roll, and the recorded normal and lateral G-accelerations¹⁸ were minimal.¹⁹

Wreckage information

With the exception of the right rudder cable, no mechanical defect was found that could have prevented the normal operation of the aircraft. The right rudder cable was found attached to the rudder, but the forward end was found with a failure near the connection to the rudder pedals. The cable was removed from the wreckage for examination by the ATSB. A preliminary examination determined it did not fail from fatigue. The aircraft's flight data demonstrated the rudder was operational during the accident sequence. On that basis, it was concluded that the rudder failure observed was a result of the impact, and no further examinations were conducted on the rudder cable assembly.

Survival factors

The aircraft was fitted with a composite roll cage within the fuselage structure to provide roll protection for the occupants. The front seats were each fitted with a four-point inflatable restraint system with an inertia reel lock. Despite coming to rest inverted after striking the ground at about 60–70 kt, the pilot and instructor reported that they found themselves uninjured, but could not open the doors with the aircraft inverted.²⁰ The inflatable restraints (air bag style system) did not activate, but this was considered likely to be due to the gradual level of deceleration.

The iBrace Survivor Questionnaire²¹ was completed for the pilot and instructor with the following results:

- The pilot was able to evacuate unassisted from the aircraft while it was filling with smoke by kicking out a window. He then pulled the instructor out of the burning wreckage after seeing her collapsed inside. He suffered from third-degree burns to 7 per cent of his body.
- The instructor was unable to evacuate unassisted from the aircraft after she became disorientated in the dark, smoke filled environment, which led to a loss of consciousness. She suffered from first and second-degree burns and smoke inhalation injuries, which required her to be intubated.

Closed-circuit television footage identified an ambulance crossing the runway towards the accident site about 3 minutes after impact. In addition, an emergency medical service helicopter was located at the airport with the crew on duty at the time of the accident. They transported the pilot and instructor to Sydney for treatment.

¹⁷ The airport camera footage timings are about 30 seconds in advance of the aircraft recorded data for reasons undetermined.

¹⁸ G load: the nominal value for acceleration. In flight, g load represent the combined effects of flight manoeuvring loads and turbulence and can have a positive or negative value.

¹⁹ The peak variation in normal and lateral accelerations were +0.24 and -0.07 respectively (datum = 0.0).

²⁰ The aircraft doors open upwards and forwards relative to the cabin with the aircraft in the upright position.

²¹ Davies J.M., Wallace W.A., Colton C.L. & Yoo K.I. (in press). Two aviation accident investigation questionnaires for passenger & crew survival factors & injuries. *Aviation Medicine and Human Performance*.

Additional information

Spatial disorientation

The pilot reported that the aircraft pitched up when he applied power for the go-around and that he observed the runway lights disappear off to the right. He felt that the aircraft was in a roll while he was trying to focus his eyes on the attitude indicator as the instructor was directing him to level the wings. He commented that without enough right rudder the aircraft will ‘pull to the left’ [when applying additional power] and that it is normal to apply right rudder, but that ‘it was pitch black’.

There is a small village, Spring Hill, located upwind of runway 11, but the instructor reported that it was not large enough to produce an illuminated horizon below about 200 ft above ground level. She reported that on the night of the accident, at low level with the runway lights obscured, it was ‘pitch black’, and that [for a pilot looking outside] the environment would have been ‘totally disorientating’.²²

Benson (1988; as cited in Gibb et al., 2011) defined spatial disorientation as:

The pilot fails to sense correctly the position, motion, or attitude of his [or her] aircraft or of himself [or herself] within the fixed coordinate system provided by the surface of the earth and the gravitational vertical.

The three sensory systems for determining orientation of the human body in space are the visual, vestibular,²³ and somatosensory²⁴ systems. Newman (2007) and others have reported that the visual system provides 80 per cent of the orientation information in normal conditions. However, in the absence of visual cues, orientation and motion information are divided between the vestibular and somatosensory systems. These systems can easily produce false information for a pilot due to local accelerations of the aircraft about the pitch, roll and yaw axes.

The vestibular system responds to head position and movement, which may lead to an incorrect perception of body motion if not supported by a visual reference. For example, an upward pitch (head backward) may be detected as a forward acceleration, and a roll as a lateral (sideways) acceleration. The somatosensory system detects local accelerations on the body, but if the pitching and rolling motions occur at close to +1G flight, such as during the accident sequence, the somatosensory system may not be able to resolve ambiguities generated by the vestibular system.

It was noted by Newman (2007) and Gibb et al. (2011) that spatial disorientation is likely an under-reported phenomena in aviation. They suggested that this may be due to it resulting in one of two likely outcomes; either the pilot recovers the aircraft with no harm or damage done, and therefore does not perceive the need to report; or it results in a fatal accident and the investigation cannot verify from the evidence available that spatial disorientation contributed to the event.

Flight instruction

Instrument flying proficiency

The Civil Aviation Safety Authority’s (2007) *Flight Instructor Manual: Aeroplane, chapter 18: Night Flying*, states the following:

Before students undertake night solo circuit operations they must have received sufficient instrument flight training to enable them [to] carry out the following manoeuvres solely by reference

²² The instructor reported that the township of Orange, to the north of the extended centreline for runway 29, provided more lighting than Spring Hill, but was partially masked by the surrounding terrain and would not have provided any significant light had that runway been used at the height at which this event occurred.

²³ The vestibular system consists of the semi-circular canals and otolith organs in the inner ear, which detect angular and linear accelerations of the head.

²⁴ The somatosensory system uses nerves to detect external forces on the body.

to instruments: a) climb and climbing turns, b) straight and level flight and level turns, c) descent and descending turns, d) unusual attitude recovery full panel.

As the pilot already held a private instrument rating, the above training exercises were not required to be conducted as lead-in to his night flying training.

Demonstration

The Flight Instructor Manual stated that ‘airborne sequences must follow an acceptable method of teaching like: *demonstrate*, *direct* then *monitor*. However, the pilot acted as flying pilot for his first night flying training flight without a prior demonstration.²⁵ The instructor explained that there were several reasons for this as follows:

- When the pilot first approached the instructor for his private instrument rating training, he was already a qualified pilot [private pilot licence] who owned his own aircraft and was capable of flying it competently. The instructor considered him an advanced student for the instrument training as he had already accumulated several hundred flying hours experience.
- The instructor used the direct method to deliver the pilot’s instrument training. This was about 40 hours of dedicated instrument flying training.
- At the time of the accident flight, the instructor and pilot had accumulated about 50 hours flying together without the need for the instructor to demonstrate a flying sequence or intervene to correct an improperly flown sequence. The pilot’s instrument flying training ensured he had accumulated sufficient minimum instrument flying prior to his first night flying training flight.

Benefit of demonstration

The benefit of demonstration as an instructional technique is that it permits the student to focus their attentional resources on key learning points for new sequences, without the diversion of those resources to managing the flight path. Studies have noted that observational experience, in addition to physical practice, can provide a more effective learning experience than physical practice alone.

In 2000, Shea et al. compared the performance of a physical practice group with a combined observation and physical practice group on a motor learning test. The physical practice group outperformed the combined practice group under the practice test conditions, but when the test conditions were varied from the practice conditions, the combined practice group ‘performed significantly better’ than the physical practice group.

Intervention

After the go-around was commenced, the instructor reported that the aircraft entered an unusual attitude. Both the instructor and pilot reported that the instructor was repeatedly directing the pilot to level the wings. The instructor commented that at the time, she was thinking ‘get that left wing up’, but directing ‘wings level’. At the time, her eyes were focused on the pilot’s attitude indicator²⁶ and she was expecting the pilot to recover the aircraft. However, the pilot had become spatially disorientated, which she was not aware of. It was only a matter of seconds between the instructor’s comprehension that the aircraft was not responding and the impact with the ground. The instructor considered that it ‘happened very fast’, and that as she was not in the habit of taking over the controls from the pilot, her natural reaction was to direct what was needed. The pilot also reported that it ‘happened very quickly’, with ‘no height to recover’.

The Cirrus SR22 is fitted with two single-handed side control yokes mounted beneath the instrument panel on the left and right side of the cockpit, and the instructor reported that it is not

²⁵ The accident flight was the instructor and pilot’s first dedicated circuit flying training session together – the instructor was not involved in the pilot’s basic flying training.

²⁶ Although the aircraft was fitted with two MFDs, the primary flight display with the attitude indicator is only displayed on the left MFD, except in the case of a failure of that MFD, in which case the primary flight display will be displayed on the right MFD.

an easy aircraft for an instructor to take over control from a student. She commented that the single-handed yokes are sensitive in their response, which can lead to 'fighting over the controls' if the instructor attempts to follow-through on the controls²⁷ while a student is flying. Therefore, she was not following through on the controls during the touch-and-go sequence.

Previous similar accidents

Spatial disorientation

Spatial disorientation presents a danger to pilots as the resulting confusion can often lead to incorrect control inputs and resultant loss of aircraft control. Gibb and others (2010) state that spatial disorientation accidents have a fatality rate of about 90 per cent, indicating how compelling the misperceptions can be. A search of contributing safety factors in the ATSB aviation occurrence database revealed that of the investigated accidents where spatial disorientation was found to be a factor (about one per year), nearly all resulted in fatal injuries.

The United States National Transportation Safety Board's database was searched for previous accidents involving spatial disorientation. A search of all aircraft categories returned 710 results. Cirrus SR20 and SR22 aircraft returned 18 results for spatial disorientation as a finding between 2003 and 2017, 13 of which were fatal accidents (four of the non-fatal accidents involved use of the Cirrus Airframe Parachute System for recovery). The conditions for all of the accidents were instrument meteorological or night, or combination of both. Of the 18 accidents for Cirrus aircraft, 10 were for instrument-rated pilots and four occurred during take-off.

The ATSB education booklet Avoidable Accidents No. 7, *Visual flight at night accidents: What you can't see can still hurt you* ([AR-2012-122](#)) outlines a number of night-time accidents that have been a result of spatial disorientation due to dark night conditions.

Loss of control during go-around

A search of the ATSB database for previous SR22 accidents involving a loss of control during a go-around manoeuvre found one result of interest:²⁸

- During a touch-and-go training exercise, the aircraft veered off the runway to the left while under full power for take-off. The pilot reported that his attention may have been diverted to the flap control lever at the time (ATSB reference number 201006782).

The United States National Transportation Safety Board's database was searched for previous similar accidents. The search criteria were Cirrus SR22, instructional flight, and accident. The search results were then filtered for loss of control events during an attempted go-around. The following results of interest were reviewed:

- Report ERA12FA540: Loss of control in-flight. 'During the final approach, witnesses saw the airplane drifting to the left while descending at a relatively high sink rate. Witnesses heard the power being adjusted, and, close to the ground, the engine went to high power. The airplane's nose rose, and the airplane veered to the left. The airplane touched down left wing down off the runway in grass, heading about 40 degrees left of the runway centreline. It then entered woods, where it hit numerous trees and came to rest upside down and on fire...Examination of the wreckage revealed no pre-existing mechanical anomalies that would have precluded normal operation'.
- Report ERA13CA222: Landing area overshoot. 'According to the instructor, he and the student pilot were practicing short field landings. When the airplane was about 20 feet above the ground on approach to the runway, the airspeed suddenly decreased. The student pilot applied

²⁷ For an instructor, 'follow-through on the controls' is the practice of holding the controls while the student is flying. This permits the instructor to feel the student's control inputs and override incorrect control inputs to prevent the development of an unsafe situation.

²⁸ There were other results of loss of control during go-around manoeuvres with full power for the SR22, but these included strong gusting wind conditions as contributing factors.

full engine power, the airplane yawed to the left, and the airplane impacted the ground before it reached the runway. The flight instructor reported no pre-impact mechanical malfunctions or failures with the airplane that would have precluded normal operation’.

- Report NYC07CA010. ‘As the pilot of the SR-22 was performing a flare for landing, the airplane’s airspeed “became too slow,” and the pilot applied full power and announced “go-around.” The airplane veered left, and continued approximately 100 yards, before it struck a tree and came to rest upright. The pilot reported no mechanical anomalies with the airplane’.

Safety analysis

Introduction

During a night training flight, a go-around from runway 11 at Orange Airport, New South Wales was commenced. Shortly after, the Cirrus SR22 aircraft, registered VH-PDC, collided with the ground. The flight instructor and pilot received serious injuries and the aircraft was destroyed.

As mentioned above, the presence of a fractured rudder cable in the wreckage was not considered a contributing factor. This was because the rate of heading change during the accident sequence followed the angle of roll, rather than the application of power, and there was no significant lateral acceleration associated with the application of power.

The data logging card did not record pilot control inputs or movement of the autopilot servos. Therefore, it could not be determined if the reversal of the initial rolling and pitching motion was the result of the actions of the pilot, or flight instructor, or the aircraft's electronic stability and protection system. However, the thresholds for activation of the aircraft's pitch and roll protection were reached during the accident sequence, and the reversal of the pitch and roll were consistent with the operation of the system. While the system was designed to mitigate an unusual attitude from developing, the act of recovering from a high pitch angle at slow speed will inevitably result in a loss of height.

The final approach on the accident flight was steep at 500 ft. While this was corrected before the landing, it would have increased the pilot's workload during the approach. Using this as a trigger to conduct a go-around would have provided the pilot with the opportunity to set up for a more stable approach on the next circuit.

This analysis will examine the conduct of flight demonstrations, and the pilot experiencing spatial disorientation and the flight instructor's awareness of such.

Flight demonstration

The pilot was undergoing his first night flying training flight for the addition of a night endorsement to his private instrument rating. The flight instructor had previously instructed the pilot for his instrument rating, and considered him an advanced student. His instrument flying training was delivered by the instructor using the instructional method of *direct*, without the need to demonstrate any sequence or intervene to correct an incorrectly flown sequence. Because of this earlier experience, the instructor elected to use the instructional method of direct without first demonstrating any of the key learning points for the night flying environment.

Night circuits involve a unique runway environment for assessing the approach path and landing, and require a unique procedure for combining visual and instrument flying sequences. The Civil Aviation Safety Authority's flight instructor manual emphasised that the 'acceptable delivery rate of new information to the student [pilot] needs to be combined with good demonstrations and adequate student practice'. Consistent with this guidance, best practice is to ensure that the student [pilot] is introduced to a new environment in a gradual way. The lack of demonstration for the pilot's introduction to night flying likely increased the risk of the pilot not having an adequate opportunity to attend to, and absorb, the key learning points before attempting to practice the sequences as the pilot flying.

Spatial disorientation

The flight instructor reported that the pilot's first night circuit was flown to a reasonable standard with the pilot responding to her direction. At the end of the second circuit, the aircraft bounced twice during the attempted touchdown and the pilot applied full power to perform a go-around. In response to the application of full power, the aircraft pitched nose-up and started to roll to the left.

The pilot reported that he lost all external visual references as the runway lighting disappeared from view underneath the aircraft, and was attempting to focus his attention on the attitude indicator as the aircraft continued to pitch up and roll left.

The pitching and rolling motion of the aircraft, in addition to the pilot and instructor reports that the external environment was 'pitch black', were all consistent with the pilot experiencing spatial disorientation. The nose up pitching motion and left rolling motion were consistent with the natural response of the aircraft without corrective pilot control input.

Flight instructor awareness

During the accident sequence, the flight instructor repeatedly directed the pilot 'wings level', but her attention was focused on the primary flight display and she was not aware the pilot had become spatially disorientated. Therefore, she did not immediately intervene to recover control of the aircraft during the accident sequence, which only lasted about 7 seconds from the decision to go-around to initial impact.

Findings

From the evidence available, the following findings are made with respect to the spatial disorientation and collision with terrain involving Cirrus SR22, registered VH-PDC, at Orange Airport, New South Wales, on 15 May 2018. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- While attempting a go-around manoeuvre from an aborted touch-and-go, the pilot did not immediately transition his scan onto the attitude indicator and became spatially disorientated, which resulted in loss of control of the aircraft and collision with terrain.
- The flight instructor was not aware the pilot had become spatially disorientated, which resulted in her providing direction rather than intervention during the loss of control.

Other factors that increased risk

- Contrary to best practice, the flight instructor elected to direct the pilot for his first night flight without a demonstration. This decision was influenced by the pilots' experience, private instrument rating, and previous instructional method.

General details

Occurrence details

Date and time:	15 May 2018 – 1903 EST	
Occurrence category:	Accident	
Primary occurrence type:	Loss of control	
Location:	Orange Airport, New South Wales	
	Latitude: 33° 22.68' S	Longitude: 149° 07.53' E

Flight Instructor details

Licence details:	Commercial Pilot Licence (Aeroplane), issued 11 February 2015
Endorsements:	Manual Propeller Pitch Control; Retractable Undercarriage; Tail Wheel Undercarriage; Spinning; Aerobatics
Ratings:	Multi Engine Aeroplane; Single Engine Aeroplane; Instrument; Night Visual Flight Rules; Flight Instructor
Medical certificate:	Class 1, valid to 24 February 2019
Aeronautical experience:	Approximately 4,200 hours
Last flight review:	3 December 2017

Pilot details

Licence details:	Private Pilot Licence (Aeroplane), issued 3 November 2016
Endorsements:	Manual Propeller Pitch Control; Retractable Undercarriage
Ratings:	Single Engine Aeroplane; Private Instrument
Medical certificate:	Class 2, valid to September 2018
Aeronautical experience:	Approximately 500 hours on Cirrus
Last flight review:	11 March 2017

Aircraft details

Manufacturer and model:	Cirrus Aircraft SR22	
Year of manufacture:	2016	
Registration:	VH-PDC	
Operator:	Intact Aviation Pty Ltd	
Serial number:	4328	
Total Time In Service	260.1 hours at last maintenance release issued 2 July 2017	
Type of operation:	Flying training – training dual	
Persons on board:	Crew – 2	Passengers – nil
Injuries:	Crew – 2 (serious)	Passengers – nil
Damage:	Destroyed	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- Cirrus Aircraft
- Civil Aviation Safety Authority
- flight instructor
- Orange City Council
- pilot
- United States National Transportation Safety Board.

References

Civil Aviation Safety Authority 2007, *Flight instructor manual: aeroplane*, issue 2, CASA, Canberra.

Gibb R, Ercoline B & Scharff L 2011, 'Spatial disorientation: decades of pilot fatalities', *Aviation, space, and environmental medicine*, vol. 82, no. 7.

Newman DG 2007, *An overview of spatial disorientation as a factor in aviation accidents and incidents*, Australian Transport Safety Bureau, Canberra. Aviation research and analysis report – B2007/0063.

Shea C, Wright D, Wulf G & Whitacre C 2000, 'Physical and observational practice afford unique learning opportunities', *Journal of motor behavior*, vol. 32, pp. 27–36

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to Cirrus Aircraft, Civil Aviation Safety Authority, flight instructor, pilot and United States National Transportation Safety Board.

The submissions from those parties were reviewed and where considered appropriate, the text of the draft report was amended accordingly.

Terminology used in this report

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing factor: a safety factor that, had it not occurred or existed at the time of an occurrence, then either: (a) the occurrence would probably not have occurred; or (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or (c) another contributing factor would probably not have occurred or existed.

Other factors that increased risk: a safety factor identified during an occurrence investigation, which did not meet the definition of contributing factor but was still considered to be important to communicate in an investigation report in the interests of improved transport safety.

Other findings: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which ‘saved the day’ or played an important role in reducing the risk associated with an occurrence.

Safety issue: a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

Safety action: the steps taken or proposed to be taken by a person, organisation or agency in response to a safety issue.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within ATSB's jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

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REPCON 1800 020 505

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Linkedin Australian Transport Safety Bureau

Investigation

ATSB Transport Safety Report

Aviation Occurrence Investigation

Loss of control and collision with terrain involving

Cirrus SR22, VH-PDC, Orange Airport, NSW, on 15 May 2018

AO-2018-038

Final – 7 June 2019