ACCIDENT

Aircraft Type and Registration:	Cirrus SR22, N936CT
No & Type of Engines:	1 Continental Motors IO-550-N piston engine
Year of Manufacture:	2009 (Serial no: 3111)
Date & Time (UTC):	6 June 2013 at 0947 hrs
Location:	On approach to Gloucestershire Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Substantial damage to wings and fuselage
Commander's Licence:	UK Private Pilot's Licence FAA Instrument rating
Commander's Age:	76 years
Commander's Flying Experience:	673 hours (of which 443 were on type) Last 90 days - 19 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further equiries by the AAIB

Synopsis

The pilot deployed the aircraft ballistic recovery system after he became disorientated on an instrument approach into Gloucester Airport. He was not injured.

History of the flight

The pilot was on a private flight from Denham Aerodrome to Gloucestershire Airport. As part of his pre-flight preparation, he had contacted Gloucestershire Airport by telephone and was informed that Runway 09 was in use.

The first part of the flight was uneventful and conducted in VMC. Initially the pilot was in contact with Farnborough ATC, who subsequently instructed him to contact Brize Norton ATC. Brize ATC instructed the pilot to climb first to 3,300 ft, then to 4,000 ft. The pilot recalls that he entered cloud shortly before flying over Oxford Airport.

When the aircraft was approximately 16 nm from Gloucestershire Airport, Brize ATC instructed the pilot to contact Gloster[1] but refused his request for a descent. When the pilot contacted Gloster he was offered an approach to Runway 27 which he accepted. At this stage, the pilot was approximately 7 nm from the initial approach fix which is located at 10 nm on the extended centreline.

Footnote

[1] Gloucestershire Airport ATC use the voice callsign 'Gloster'.

The pilot established the aircraft on the final approach track for an RNAV approach onto Runway 27 with the autopilot engaged in GPS approach and vertical speed modes. At approximately 1,800 ft amsl the autopilot was disconnected for approximately 5 seconds, during which the aircraft rolled to approximately 30° left bank. When the pilot reinstated the autopilot, it engaged in PITCH HOLD and ROLL HOLD[2] modes, which are the default modes for the system. The pilot did not notice that the autopilot modes had changed and, observing that the aircraft was maintaining a banked turn, attempted to override the autopilot to regain a wings level attitude. After a further 18 seconds, the pilot disconnected the autopilot for a second time but the aircraft had now deviated from the approach centreline. The pilot stated that while trying to correct the situation he "over-controlled" the aircraft in roll and subsequently in pitch. During the following 80 seconds, the aircraft exhibited large variations of pitch, roll, speed and altitude as the pilot attempted to bring the aircraft under control. A series of warnings occurred including an overspeed and terrain proximity warning, and the pilot observed a large red 'V' on the primary flight display (PFD)[3]. At this point the aircraft was still in cloud and, assessing that he was too close to the ground to recover from what he described as an out-of-control situation, he decided to deploy the ballistic recovery system. The pilot reported that he only became VMC at about the same time as the parachute deployed.

The aircraft came to rest in the garden of a suburban house and was substantially damaged; the pilot was uninjured.

Footnote

[2] The aircraft was fitted with a Cirrus Perspective system. In these modes the autopilot will try, within certain limits, to maintain the pitch and roll attitude at the time of engagement.

[3] When the aircraft enters an unusual pitch attitude, red extreme pitch warning chevrons pointing toward the horizon are displayed on the Attitude Indicator, starting at 50˚ above and 30˚ below the horizon line.

The pilot stated that the combination of the unexpected runway change and the delay in being allowed to descend to the required height to commence the approach resulted in him experiencing high workload and stress.

Automatic flight control system (AFCS)

The AFCS has four main operating functions: autopilot, flight director, yaw damper and electric pitch trim. The autopilot controls the aircraft pitch and roll attitudes using flight control surface servos following commands received from the flight director based on the active modes. The servo mounts are equipped with slip-clutches set to certain values and this allows the pilot to override the servos.

The autopilot also has an automatic levelling function activated by pressing the LVL key on the AFCS control panel. Pressing the LVL key engages the autopilot (if the autopilot is disengaged and the aircraft is within the autopilot engagement limitations[4]) and the aircraft is commanded to fly to zero bank angle and zero vertical speed. When the LVL key is pressed, all armed and active autopilot modes are cancelled and the autopilot and flight director revert to LVL mode for pitch and roll. Activation of the stall warning system at any stage of flight will disconnect the autopilot including the LVL mode if engaged.

Ballistic recovery system

The ballistic recovery system (BRS) consists of a parachute, a solid fuel rocket to deploy the parachute, an activation handle and a harness imbedded within the fuselage structure. A three-point harness connects the aircraft fuselage structure to the parachute. The pilot can activate the system by pulling the handle located on the cockpit ceiling. This deploys the rocket out of a

Footnote

[4] The autopilot engagement limits are ±30° in pitch ±75° in roll.

hatch on the top of the aircraft behind the cockpit. The rocket pulls the parachute from the hatch, the embedded forward harness straps pull through the fuselage skin and the aircraft will then descend in a more or less level attitude.

Weather

The 0950 hrs weather report from Gloucestershire Airport indicated surface wind from 040° at 8 kt, visibility 8,000 m, scattered cloud at 500 ft, broken cloud at 800 ft, temperature 11°C, dewpoint 8°C and pressure 1023 hPa.

Pilot training

The pilot had received training in a Cirrus simulator during which he practised using the BRS in response to various emergencies. The pilot stated that this training was beneficial in dealing with the situation he faced. He had not received any training involving the use of the LVL function.

Recorded data

The aircraft was fitted with a Cirrus Perspective avionic system, based on the Garmin G1000 system. The system had an SD card installed which enabled the collection of flight data that would otherwise be lost. The aircraft was also fitted with a Recoverable Data Module (RDM), which would not download. The data from the display system was analysed and is shown in Figure 1.

At 0942 hrs the aircraft was at 2,000 ft amsl flying to Gloucestershire airport from the east on a heading of 269°M, with an IAS of 84 kt. The AFCS was engaged and in the GPS roll mode and ALT pitch mode. The AFCS pitch mode was changed to VS as the aircraft started to descend. At 0942:57 hrs, the AFCS was manually disconnected as indicated by the recorded AFCS status value of 5, which is linked to a flashing caption on the display. At 0943:05 hrs the AFCS was recorded as ON again, with the default pitch and roll modes of PITCH HOLD and ROLL HOLD; the aircraft was pitched down 9.4° and had 23.4° of left roll at this time so these values were set by the AFCS as the commanded pitch and roll values.

At 0943:23 the AFCS was manually disconnected again and levelled at approximately 1,400 ft amsl with a relatively stable speed, neutral pitch but not a stable roll or heading. At 0943:40 hrs a right roll was initiated that reached 81.9°, with a commensurate rapid descent and speed increase, until the aircraft levelled at 1,000 ft amsl, heading for the airfield. The aircraft then climbed at a rate that peaked at 2,988 ft/min until it reached 1,771 ft amsl with a speed that had reduced to 54.6 kt. At this point the aircraft rapidly rolled left and the nose dropped. The descent stopped at 880 ft amsl, with an IAS of 144 kt after having exceeded 10,000 ft/min. The cycle of a high pitch climb, reduction in airspeed and accelerating descent was then repeated until the recording stopped in the descent as a result of the BRS being deployed.

Analysis

When the pilot commenced the approach, the aircraft was being flown with the autopilot engaged in approach and vertical speed mode. When the pilot reengaged the autopilot after the first disconnection, the autopilot engaged in default modes of PITCH HOLD and ROLL HOLD. However, probably due to the high workload he was experiencing, the pilot did not notice that the autopilot was now operating in different modes from before. The pilot expected the aircraft to continue on the approach centreline and, when he noticed that the aircraft was maintaining a left bank, he overrode the autopilot in an attempt to level the aircraft. As the autopilot was still engaged, every time the pilot relaxed on the controls the aircraft tried to regain the roll attitude

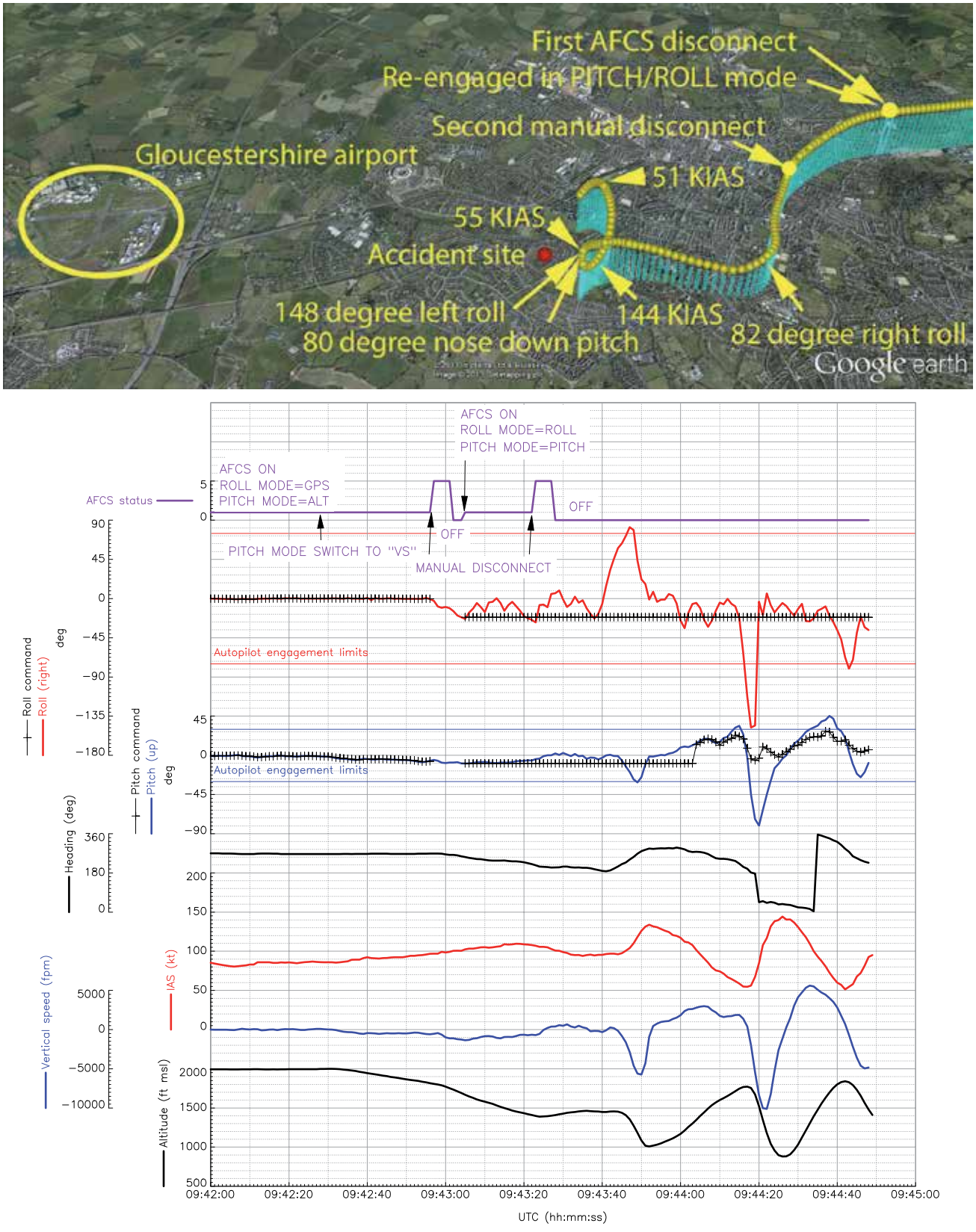

Figure 1

Data recovered from the display

that existed at the time of engagement. This unfamiliar aircraft behaviour led to a series of roll oscillations as the pilot intermittently overrode the autopilot. After approximately 18 seconds, the pilot again disconnected the autopilot but the aircraft was displaced left of the approach centreline. By this stage, the pilot was confused and distracted by the unexpected aircraft behaviour and, in his attempts to regain the approach path, he started over-controlling in roll and then in pitch. The variations of pitch, roll, height and airspeed increased to the extent that he became disorientated and, when he assessed that he could not safely regain control, he operated the BRS. The training the pilot had received in the use of the BRS assisted him in deciding to use, and actually deploying, the system. Although the pilot did not activate the automatic levelling system, once the flight path deviations commenced, at times the aircraft was outside the autopilot engagement limits and, under these circumstances, the LVL mode could not have been engaged.

Conclusion

The initial disengagement and re-engagement of the autopilot caused the system to engage in default modes that the pilot was not expecting and, due to high workload, did not notice. The distraction and confusion caused by the unexpected aircraft response caused him to over-control in pitch and roll which further increased workload and led to him becoming disorientated to the extent that he felt he was unable to control the aircraft safely.