Aviation Investigation Final Report

Location:	CONCORD, North Carolina	**Accident Number:**	ERA16LA085
Date & Time:	January 8, 2016, 15:38 Local	**Registration:**	C-GXXJ
Aircraft:	Cirrus SR22	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The instrument-rated private pilot was conducting a cross-country instrument flight rules flight in instrument meteorological conditions. The pilot reported that, during an instrument landing (ILS) approach, he engaged the autopilot with the intent of flying an autopilot-coupled approach, but the airplane subsequently flew below the glideslope and off course. Review of recorded data revealed that the airplane's automated systems were not properly configured to automatically transition from GPS waypoint navigation mode to the navigation (NAV) mode; therefore, the autopilot did not capture the ILS. After the airplane passed the final approach fix (FAF), the pilot disengaged and then re-engaged the autopilot in the attitude hold mode, at which time, the roll attitude was about 15° left. The airplane drifted left of course and subsequently flew below the glideslope. The air traffic controller subsequently canceled the approach clearance and provided radar vectors to another airport about 15 miles away. Based on this information, it is likely the pilot’s mismanagement of the airplane’s automated systems (autopilot, GPS, and navigation radios) led to its failure to capture the ILS and necessitated the missed approach.

About 5 minutes after the missed approach, the controller provided the pilot with radar vectors to the FAF for a GPS approach at the diversionary airport. The pilot reported that, he thought he had engaged the autopilot to fly directly to the FAF and that the airplane subsequently began to climb and bank sharply right. The data showed that the pilot had mistakenly programmed the GPS/autopilot to fly to the initial approach fix (IAF), which was behind and right of the airplane, instead of the FAF. Due to the pilot’s mismanagement of the airplane’s automated systems (GPS and autopilot), when he attempted to activate the approach near the FAF, the autopilot attempted to turn the airplane right toward the IAF, contrary to the pilot’s intent.

After air traffic control canceled the second approach clearance, they provided the pilot with radar vectors for a third instrument approach attempt. The recorded data showed that the pilot made a series of inputs to the autopilot that resulted in the airplane climbing when he expected it to descend, and shortly

thereafter, the autopilot's underspeed envelope protection mode activated in order to avoid entering an aerodynamic stall. When queried about the airplane's altitude by air traffic control, the pilot appeared to be confused as to why the airplane was climbing. Further, when the controller queried the pilot about which direction the airplane was headed, he indicated that he thought the autopilot was navigating to a fix, when in reality it was in a mode to follow a prescribed heading.

During the final minutes of the flight, after air traffic control provided the pilot a low altitude alert, the autopilot modes changed several times while the airplane began maneuvering to extreme roll and pitch attitudes. During this time, the pilot attempted to activate the autopilot's straight and level mode three times. The first time the pilot activated the mode, he deactivated it six seconds later. He then attempted to activate the straight and level mode again, but the pilot held the button down, delaying its activation. After the mode activated, the roll returned to level, but the airplane increased its pitch to 20° nose up. As the pitch attitude increased, the autopilot commanded nose down trim, an indication that the autopilot was opposing the pilot's nose up forces to the control stick. This evidence indicates that the pilot continued to exhibit confusion about the way the airplane's automated systems worked together with the autopilot.

The pilot then disconnected the autopilot and reactivated the straight and level mode for the third and final time after the pitch attitude reached 60° nose up and about 120° left roll. After the activation, the pitch and roll began to decrease toward a wings level attitude. About that time, the pilot activated the airplane's parachute system. The airplane subsequently descended into a residential area and during the landing, the left wing was substantially damaged. The pilot and passenger were not injured.

Postaccident review of all recorded data showed that the airplane and its automated systems performed as expected given the inputs provided by the pilot. It is likely that the pilot's continuous mismanagement of the airplane's automated systems ultimately led to his loss of airplane control during the third instrument approach attempt, which necessitated his eventual activation of the airplane's parachute system.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The pilot's inadequate management of the airplane's automated systems, which resulted in a loss of control during an instrument approach and necessitated his subsequent deployment of the airplane's parachute system.

Findings

Personnel issues	Understanding/comprehension - Pilot
Aircraft	Autopilot system - Incorrect use/operation

Factual Information

History of Flight

Approach-IFR initial approach	Loss of control in flight (Defining event)
Emergency descent	Collision with terr/obj (non-CFIT)

On January 8, 2016, at 1538 eastern standard time, a Cirrus SR22, Canadian registration C-GXXJ, was substantially damaged when it was involved in an accident near Concord, North Carolina. The pilot and passenger were not injured. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 personal flight.

Near the end of a cross-country, instrument flight rules flight, the pilot was conducting an instrument landing system (ILS) approach to runway 36R at Charlotte/Douglas International Airport (CLT), Charlotte, North Carolina, in instrument meteorological conditions. The pilot provided a narrative description of the flight in writing and during an interview. According to the pilot, during the ILS approach, both flags on the primary flight display (PFD) were white and centered, which indicated that the autopilot was engaged, and the glideslope was captured. He then saw a "vertical flag drop" on the PFD, which indicated that the airplane was below the glideslope, but the autopilot did not correct for the deviation. As the airplane broke through a cloud layer and entered visual meteorological conditions, the pilot noted that, although the PFD was showing the flag white and centered, indicating that the airplane was laterally on course, the runway was actually to his right.

Review of data downloaded from the airplane's PFD, multi-function display, and autopilot, as well as air traffic control voice communication and radar data recordings provided by the Federal Aviation Administration (FAA), revealed that at 1509:00, the airplane descended through a pressure altitude of 3,200 ft about 1.4 miles before the final approach fix (HAYOU) for the ILS approach to runway 36R. At that time, the autopilot mode changed from GPS Steering-Vertical Speed mode (GPSS-VS) to GPSS-Approach (APP)-VS mode. The primary navigation source, which was selectable on the PFD, was in the VHF/VLOC 1 mode. In this condition, the autopilot would not automatically transition from the GPSS mode to the navigation (NAV) mode for the ILS approach, and the glideslope would not arm. If the primary navigation source had been set to GPS, the autopilot would have automatically transitioned to NAV mode and captured the glideslope. In this case, with no other intervention, after the airplane passed the final approach fix, the GPS unit would no longer provide navigation/steering guidance to the autopilot, and the PFD would annunciate a yellow "GPSS Invalid" message. The recorded data indicated this message was displayed at 1509:39, just after the airplane passed HAYOU. At that time, the airplane was on the localizer centerline, and above the glideslope with a full "fly down" indication on the PFD. In this condition, the autopilot would attempt to maintain wings-level (laterally) and continue to maintain the selected vertical speed. After passing HAYOU, the airplane continued toward CLT, drifted right of the localizer course, and continued to descend at about 500 ft per minute. At 1510:08, about 1.5 miles and 32 seconds after passing HAYOU, the autopilot was disconnected, and the airplane drifted further to the right of the localizer course, reaching a 60% scale "fly left" indication on the PFD. At

1510:16, the autopilot was re-engaged in the Pitch-Roll (attitude hold) mode, which holds the pitch and roll attitude at the time of activation. At the time, the roll attitude was about 15° left wing down, the pitch attitude was about 2° nose down, and the airplane drifted left of the localizer course. At 1510:44, the PFD indicated a full scale “fly right” indication.

At 1510:52, as the airplane descended through the glideslope, the CLT tower controller advised the pilot that that the airplane was left of course and asked if he was still receiving the localizer. The pilot responded “yeah, off course.” The controller advised that he saw that the airplane was correcting and asked the pilot if he wanted to continue. The pilot responded, “we’re trying to correct.” At 1511:08, the PFD displayed a full scale “fly up” indication. At 1511:20, the autopilot was disengaged. Two seconds later, the controller advised the pilot that the airplane was still drifting left, canceled the approach clearance, and instructed the pilot to turn right to a heading of 090° and climb and maintain 4,000 ft. The pilot responded, “we’ve got the airport in sight”. The controller replied, “unable, turn right 090, climb and maintain 4,000 ft. The controller subsequently asked the pilot to “turn right immediately” three times, and at 1511:36, the airplane began a turn to the right started to climb.

Following the missed approach at CLT, the pilot recalled that he flew the airplane without the assistance of the autopilot and that air traffic control provided him with radar vectors to Concord-Padgett Regional Airport (JQF), Concord, North Carolina. The controller asked him if he was able to fly a GPS approach to runway 2, and he replied that he could. The controller provided an approach fix; however, the pilot was initially unable to look it up, as he thought the controller indicated that it was for runway 20. After clarifying, the pilot found the appropriate fix. He input the runway into his GPS unit and loaded the approach.

Review of the recorded data showed that, following the missed approach at CLT, the approach controller asked the pilot where he would like to go and suggested the GPS approach to runway 2 at JQF. At 1515:44, the controller instructed the pilot to proceed direct to ECEGA, which was the final approach fix for the GPS approach to runway 2 at JQF. The pilot responded, “what runway?”, the controller advised that it was runway 2, then repeated and spelled out ECEGA. At 1516:24, the controller asked the pilot if he was descending to get on the approach, the pilot confirmed he was, and asked for the “initial fix.” The controller responded that the fix he wanted the pilot to go to was ECEGA, which he again spelled out. The pilot asked if that was for the ILS approach to runway 20, and the controller advised that it was for the GPS approach to runway 2 at JQF. The pilot responded, "[unintelligible] two zero approach."

At 1516:48, the pilot began to explain to the controller that he wasn’t able to look up the ECEGA fix and listed other fixes that he could find (MEATT and NASCAR), which were associated with the GPS approach to runway 20 at JQF. The controller inquired if the pilot was able to fly a GPS approach and asked if he instead needed an ILS approach; the pilot did not respond. The controller again called the pilot, and over several radio transmissions, the pilot confirmed that he could fly a GPS approach. By this time, the airplane had flown too far to the east to make the left turn toward ECEGA. At 1517:48, the controller began vectoring the airplane south and then west to return toward the approach. At 1519:44, the controller asked the pilot to verify that he had the approach “plugged in” and was ready for the approach. The pilot responded that he had the GPS approach plugged in for runway 20, but he did not have the initial fix that the controller had previously provided. The controller clarified that the approach should be for runway 2, not runway 20. The controller and the pilot then discussed the names of the fixes for the runway 2 approach, and the pilot confirmed that he now had the appropriate fixes.

In his written statement, the pilot described that, as he proceeded to establish the inbound course for the instrument approach, he engaged the autopilot to fly direct to ECEGA, which was the final approach fix (FAF) for the GPS runway 2 approach at JQF. As he engaged the autopilot, the airplane began to climb and turned sharply to the right. He tried to engage the autopilot's "straight and level" mode, but there was no response from the autopilot.

Review of the recorded data revealed that, at 1521:00, the controller advised the pilot that he was 4 miles from ECEGA, instructed him to fly heading 360° and maintain 3,000 ft until established on the final approach course, and cleared the pilot for the GPS approach to runway 2 at JQF. The pilot acknowledged. At 1521:24, the autopilot was in the GPSS-Altitude (ALT) mode, and the next waypoint was set to ECEGA. At 1523:04, the pilot transmitted "ok now I have to activate my appro[ach]." About 8 seconds later, the next waypoint changed from ECEGA (the final approach fix) to LALEC (the initial approach fix), with the autopilot in the GPSS-ALT mode. At that time, LALEC was about 9 miles behind and to the east (right) of the airplane's position. The airplane began a turn to the right. At 1523:07, the controller instructed the pilot to contact the JQF tower, and the pilot acknowledged. At 1523:32, the autopilot was disconnected, and the airplane turned back to the left, toward COKBA, which was the next step-down fix on the approach after ECEGA. About ½ mile south of COKBA, the autopilot was re-engaged in the Roll-Pitch mode, and the airplane entered a turn to the right and began heading southeast. At 1525:08, the autopilot was disconnected, and the airplane made a sharp turn to the left, reversing course toward the northwest. During the turn, the roll attitude reached a peak value of 73° left, and the pitch attitude oscillated between 5° nose down and 25° nose up. At 1525:09 the autopilot straight and level mode was activated. At the time of activation, the roll attitude was about 36° left, the pitch attitude was about 25° nose up. About 7 seconds after activation, the roll attitude was 0°, and about 4 seconds later, the pitch attitude was 2° nose up, which were the target values for the straight and level mode.

At 15:25:52, the JQF tower controller advised the Charlotte approach controller that the pilot had "just lost his course guidance for some reason" and advised that he instructed the pilot to discontinue the approach to JQF. The two controllers then agreed to instruct the pilot to fly northwest and climb to 3,000 ft, and the JQF controller handed off the flight back to the Charlotte approach controller. The airplane then continued northwest for about 9 miles, passing west of JQF with the autopilot in the heading (HDG) mode. At 2028:51, the approach controller offered the pilot the ILS approach to runway 20 at JQF, and the pilot accepted. The controller instructed the pilot to fly a heading of 020 and to climb and maintain 3,300 ft. The autopilot mode then changed to HDG-VS just prior to turning north. The airplane continued north for about 8 miles, with the autopilot mode changing to HDG-ALT about halfway through the northbound leg.

At 15:33:01, the controller instructed the pilot to turn right to a heading of 100°, descend and maintain 3,000 feet, and the pilot acknowledged. At 1533:16, the airplane began a turn to the east, and the autopilot mode changed to HDG-VS-ALT, an altitude capture mode. The pilot engaged this mode prior to adjusting the vertical speed and altitude target bugs, which remained at 0 and 3,300 ft, respectively. With no vertical speed selected, the autopilot will automatically set the bug to 500 ft per minute in the direction of the target altitude bug setting. At the time of engagement, the altitude was 3,289 ft. As a result, the airplane began to climb at a rate of 500 ft per minute. About 3 seconds later, the pilot reduced the altitude bug setting to 3,000 ft. In this condition, the autopilot has an "illogical" combination of inputs; it is set to climb at 500 ft per minute, with a target altitude below the current altitude. When this occurs, the autopilot will attempt to maintain the selected vertical speed and ignore the altitude target,

indefinitely. As a result, the airplane began a climb. The autopilot manual advises to set the vertical speed and altitude bugs prior to activating the altitude capture mode to avoid this situation.

At 1533:56, the autopilot envelope protection “underspeed” mode was activated briefly (less than 6 seconds) at an airspeed of about 85 knots. The underspeed mode will attempt to lower the nose and limit the maximum bank angle to avoid a stall. At 1534:20, the controller asked the pilot “say altitude” and the pilot responded, “I’m at thirty-seven for some reason its climb[ing].” At 1534:24, the airplane turned right toward the southeast, the underspeed mode was activated and remained activated for about 1 minute. At 1534:50, the controller asked the pilot if he was turning southbound, and the pilot replied, “it looks like it’s going to GLISS” (the precision final approach fix for the ILS runway 20 approach at JQF). However, at that time the autopilot remained configured in the HDG-VS-ALT mode (with the underspeed mode also activated) with the heading bug set to 100°, the vertical speed set to 500-ft per minute climb, and the altitude bug set to 3,000 ft. The controller advised the pilot that he could join the localizer at GLISS; the pilot did not respond. At 1535:00, the next waypoint on the PFD changed to GLISS; however, the autopilot remained in the HDG-VS-ALT mode. At 1535:12, the autopilot was disconnected and then re-engaged 12 seconds later in the GPSS-Pitch mode with GLISS as the next waypoint. At 1535:42, the controller advised the pilot that if he was headed to GLISS, to join the final approach course at GLISS, and maintain 2,400 ft until GLISS. The pilot did not respond. At 1535:48, the autopilot was disconnected.

The pilot recalled that, around this point in the flight, he received "terrain" and "envelope protection" warnings, as well as an advisory from the controller indicating he was "too low and needed to climb." He pushed the straight and level button again, but the airplane did not respond as expected.

Review of the data showed that during the final minutes of the flight, at 1535:59, the controller provided the pilot a low altitude alert, and the pilot did not respond. At 1536:38, the autopilot was re-engaged in the Roll-Pitch mode and immediately changed to the GPSS-Pitch mode, with no waypoint selected. The airplane then made a sharp turn to the right (west). Over the next 30 seconds, the roll attitude reached 100° to the right before it reversed, and then reached 170° left. Over the same period, the pitch attitude decreased to about 25° nose down before it reversed to about 80° nose up, then reversed again to about 80° nose down. At 1536:54, the straight and level mode was activated for about 6 seconds, then the autopilot (and the straight and level mode) was deactivated for about 8 seconds, then reengaged in the straight and level mode at 1537:08.

Detailed review of the recorded data revealed that the autopilot responded when the straight and level mode was activated; however, that mode does not become active until the straight and level button is released. The data recorded by the autopilot unit revealed that, during the second activation, the button was pressed at 1536:49, at which time the pitch attitude was about 20° nose down and increasing, and the roll attitude was about 60° right and decreasing. The button was released (and the mode activated) about 1536:54, at which time the pitch attitude was about 0° and the roll attitude was about 20° right. During the activation, the roll reduced to 0°, the pitch rate decreased, but the pitch attitude increased to about 20°. As the pitch increased, the autopilot commanded nose down trim until the autopilot was deactivated about 1537:00. The third straight and level mode activation occurred at 1537:08, when the pitch attitude was about 60° degrees nose up and decreasing, and the roll attitude was about 120° left and increasing.

The pilot stated that, when the straight and level mode did not respond as he expected, and as he started to "experience G forces," he deployed the airplane's parachute system and secured the engine. The airplane descended into a residential area and came to rest on a chain link fence in the backyard of a residence.

The recorded data showed that, after the final activation of the straight and level mode, the airplane's pitch attitude continued to decrease, and the roll attitude began to decrease. At 1537:14, a decrease in airspeed followed by a significant longitudinal deceleration was recorded, consistent with the airframe parachute deployment. At that time, the airplane was at 1,500 ft msl with an indicated airspeed of 85 knots, a pitch attitude of 80° nose down and a roll attitude of 130° to the left.

Postaccident examination of the airplane by an FAA inspector revealed that the underside of the left wing was substantially damaged and that the flaps were retracted. The parachute remained attached to the airplane through its harness.

The airplane was equipped with a PFD, MFD and autopilot, all of which included data recording capabilities. These devices were recovered following the accident and were forwarded to the NTSB Vehicle Recorder Laboratory for data recovery and analysis. The airplane was also equipped with dual VHF/GPS navcomm systems which supplied data to the PFD, MFD, and autopilot. Review of the recorded data did not reveal evidence of any autopilot or other system anomalies.

The pilot held a commercial pilot certificate with ratings for airplane single-engine land and instrument airplane. At the time of the accident, he had accumulated 1,372 total hours of flight experience, of which 900 hours were in the accident airplane make and model. He had also accumulated 546 hours of flight experience while operating in instrument meteorological conditions, of which 9 hours were accumulated in the 90 days preceding the accident. Examination of the pilot's logbook revealed that he had logged 9 instrument approaches in the 6 months preceding the accident, all of which were in the accident airplane..

Pilot Information

Certificate:	Private	**Age:**	65,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	September 13, 2013
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	September 11, 2015
Flight Time:	1372 hours (Total, all aircraft), 900 hours (Total, this make and model), 1372 hours (Pilot In Command, all aircraft), 12 hours (Last 90 days, all aircraft), 6 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cirrus	**Registration:**	C-GXXJ
Model/Series:	SR22	**Aircraft Category:**	Airplane
Year of Manufacture:	2003	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	0729
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	September 21, 2015 Annual	**Certified Max Gross Wt.:**	3600 lbs
Time Since Last Inspection:	26 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1503 Hrs at time of accident	**Engine Manufacturer:**	Continental Motors
ELT:	C126 installed, not activated	**Engine Model/Series:**	IO550N27B
Registered Owner:	On file	**Rated Power:**	310 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	JQF,705 ft msl	**Distance from Accident Site:**	7 Nautical Miles
Observation Time:	15:40 Local	**Direction from Accident Site:**	180°
Lowest Cloud Condition:		**Visibility**	3 miles
Lowest Ceiling:	Overcast / 500 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots / None	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	340°	**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	30.07 inches Hg	**Temperature/Dew Point:**	7°C / 6°C
Precipitation and Obscuration:	N/A - None - Mist		
Departure Point:	ERIE, PA (ERI)	**Type of Flight Plan Filed:**	IFR
Destination:	CHARLOTTE, NC (CLT)	**Type of Clearance:**	IFR
Departure Time:	11:00 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	35.509445,-80.713333(est)

Administrative Information

Investigator In Charge (IIC):	Brazy, Douglass
Additional Participating Persons:	Paul D Meyer; Federal Aviation Administration; Charlottte, NC Brannon Mayer; Cirrus Aircraft; Duluth, MN John Kent; Continental Motors; Mobile, AL Fred Barber ; Avidyne; Melbourne, FL
Original Publish Date:	May 20, 2021
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=92553