Aviation Investigation Final Report

Location:	Pellston, Michigan	**Accident Number:**	CEN13FA135
Date & Time:	January 15, 2013, 20:00 Local	**Registration:**	N1120N
Aircraft:	Cessna 208B	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of visual reference	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

The pilot landed at the airport to refuel the airplane and pick up cargo. The pilot spoke with three employees of the fixed base operator who stated that he seemed alert and awake but wanted to make a "quick turn." After the airplane was fueled and the cargo was loaded, the pilot departed; the airplane crashed 1 minute later. Night visual meteorological conditions prevailed at the time. An aircraft performance GPS and simulation study indicated that the airplane entered a right bank almost immediately after takeoff and then made a 42 degree right turn and that it was accelerating throughout the flight, from about 75 knots groundspeed shortly after liftoff to about 145 knots groundspeed at impact. The airplane was climbing about 500 to 700 feet per minute to a peak altitude of about 260 feet above the ground before descending. The simulation showed a gas generator speed of about 93 percent throughout the flight. The study indicated that the load factor vectors, which were the forces felt by the pilot, could have produced a somatogravic illusion of a climb, even while the airplane was descending. The postaccident examination of the airframe and engine revealed no evidence of mechanical malfunctions or failures that would have precluded normal operation. Based on the findings from the aircraft performance GPS and simulation study, the degraded visual reference conditions present about the time of the accident, and the forces felt by the pilot, it is likely that he experienced spatial disorientation, which led to his inadvertent controlled descent into terrain.

Probable Cause and Findings

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

The pilot's inadvertent controlled descent into terrain due to spatial disorientation. Contributing to the accident was lack of visual reference due to night conditions.

Findings

Aircraft	Directional control - Not attained/maintained
Personnel issues	Spatial disorientation - Pilot
Environmental issues	Dark - Effect on personnel

Factual Information

History of Flight

Initial climb	Collision with terr/obj (non-CFIT)
Initial climb	Loss of visual reference (Defining event)

On January 15, 2013, at 1958 eastern standard time, a Cessna 208B airplane, N1120N, collided with trees shortly after departing from Pellston Regional Airport of Emmet County (KPLN), Pellston, Michigan. The commercial pilot, the sole occupant, was fatally injured and the airplane was destroyed. The airplane was registered to Aero Leasing and operated by Martinaire Aviation, L.L.C. under the provisions of 14 Code of Federal Regulations Part 135 as a cargo flight. Night visual meteorological conditions prevailed and an instrument flight rules (IFR) flight plan was filed. The flight was originating from KPLN at the time of the accident and was enroute to Capital Region International Airport, (KLAN), Lansing, Michigan.

The pilot had flown from Chippewa County International Airport (KCIU) and landed at KPLN to refuel the airplane and pick up 570 pounds of cargo. The pilot interacted with 3 employees of the fixed base operator (FBO) who stated that he seemed alert and awake, but wanted to make a "quick turn" at KPLN. After the airplane was refueled and the cargo was loaded, the pilot taxied to runway 23 and departed.

An analysis of the data recovered from the pilot's Garmin 696 handheld GPS, revealed that the airplane entered a right bank almost immediately after takeoff, and climbed to an altitude of about 260 feet above ground level (AGL) before it began to descend. At the time that the last data point was recorded on the GPS, the airplane was at an altitude of about 175 feet AGL and traveling at 127 knots. The airplane impacted trees and came to rest in a heavily wooded area.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	26
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	August 9, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	December 7, 2012
Flight Time:	1921 hours (Total, all aircraft), 34 hours (Total, this make and model), 1808 hours (Pilot In Command, all aircraft)		

The pilot, age 26, held a commercial pilot certificate for airplane single engine land, airplane multiengine land, and instrument airplane, which was issued on May 6, 2011. He also held a certified flight instructor certificate for airplane single engine land, airplane multi-engine land, and instrument airplane. The pilot was issued a Class 1, Limited Medical Certificate with the limitations "Must wear corrective lenses", on August 9, 2012. On this medical application, the pilot reported that his flight experience included 2,000 total hours and 100 hours in the preceding six months.

According to the pilot's logbooks, he accumulated 1,921 total hours, 142 hours at night, 47 hours in actual instrument conditions, and 34 hours in the accident airplane make and model.

The pilot began training with Martinaire in the accident airplane make and model on November 26, 2012. He successfully completed the training and subsequent check ride on December 7, 2012. Upon completion of training, the pilot began his initial operating experience (IOE) with a Martinaire senior captain on January 7, 2013 and completed IOE on January 11, 2013. The pilot began flying solo flights for Martinaire on January 12, 2013. He was deemed proficient to fly in IFR conditions and was current during the accident flight.

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N1120N
Model/Series:	208B	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	208B0386
Landing Gear Type:	Tricycle	**Seats:**	2
Date/Type of Last Inspection:	December 31, 2012 AAIP	**Certified Max Gross Wt.:**	8785 lbs
Time Since Last Inspection:		**Engines:**	1 Turbo prop
Airframe Total Time:	10132 Hrs at time of accident	**Engine Manufacturer:**	P&W
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	PT6A-114A
Registered Owner:	AERO LEASING	**Rated Power:**	675 Horsepower
Operator:	Martinaire Aviation, L.L.C.	**Operating Certificate(s) Held:**	On-demand air taxi (135)

The Cessna 208B, two seat, high wing, fixed landing gear airplane, serial number 208B0386, was manufactured in 1994. It was powered by one Pratt & Whitney PT6A-114A, 675 shaft horsepower engine, equipped with a three bladed constant-speed McCauley propeller. The airplane was maintained on an approved aircraft inspection program. On December 31, 2012, an engine logbook entry revealed that the engine had 5,054.8 hours since overhaul, 7,527 cycles since overhaul, and 2,945.2 hours until the next overhaul. On January 14, 2013, an airframe logbook entry revealed that the airplane's total time was 10,132.1 hours.

On January 15, 2013, prior to departing KCIU, the accident pilot reported that the left side attitude

indicator was inoperative. The attitude indicator was removed, replaced, and the airplane was returned back into service.

A weight and balance form for the accident flight was located at the accident scene. However, the calculations for the accident flight were not completely filled out.

Weight and balance computations were performed using four different scenarios provided by the operator. All four scenarios resulted in the airplane being within the center of gravity limits.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	PLN,721 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	23:54 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	Broken / 3600 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots / 16 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	210°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.13 inches Hg	**Temperature/Dew Point:**	-3°C / -9°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Pellston, MI (PLN)	**Type of Flight Plan Filed:**	IFR
Destination:	Lansing, MI	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	

At 1854, the automated weather reporting station located at KPLN, reported: wind from 210 degrees at 10 knots gusting to 16 knots, visibility 10 miles, cloud ceiling broken at 3,600 and 4,800 feet, ceiling overcast at 5,500 feet, temperature minus 3 degrees Celsius (C), dew point minus 9 degrees C and the barometric pressure of 30.14 inches of Mercury. There was no automated report issued around the time of the accident. The next automated report was at 2054 and the conditions were: wind from 210 degrees at 12 knots gusting to 17 knots, visibility 10 miles, ceiling overcast at 5,000 feet, temperature minus 3 degrees C, dew point minus 8 degrees C, and barometric pressure was 30.10 inches of Mercury.

An interview was conducted with a pilot, flying the same make and model airplane as the accident airplane, who took off 5 to 10 minutes prior to the accident. The pilot described the conditions to be "bumpy" and that when the wind was out of the southwest there was usually turbulence. He noticed on his GPS that around 1,000 feet AGL the wind was "right on the nose at 36 knots." The pilot stated that he flew visual flight rules (VFR) to 6,000 feet and ice was not present. He described taking off from runway 23 at night as "a black hole" and would utilize his cockpit instruments after climbing above a couple hundred feet AGL.

According to statements provided by two of the FBO employees, the conditions were "windy" around the time of the accident. One of the employees stated that the engine sounded fine and was similar to the

rest of the planes he encountered at the airport.

Airport Information

Airport:	PELLSTON RGNL AIRPORT OF EMMET PLN	**Runway Surface Type:**	Asphalt
Airport Elevation:	720 ft msl	**Runway Surface Condition:**	Snow;Wet
Runway Used:	23	**IFR Approach:**	None
Runway Length/Width:	5401 ft / 150 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	45.563331,-84.82611(est)

The accident site was located at 45° 33' 50.7" N, 084° 49' 42.3" W, elevation 714 feet mean sea level (MSL), in a heavily wooded area covered in snow. The main wreckage was wrapped around 2 trees and mostly broken apart. The wreckage scene was about 330 feet long and began at the top of the trees on a heading of about 270 degrees. The wreckage began with portions of the wings, continued with scattered debris, then the main wreckage, more scattered debris, and finally the propeller. The initial impact points were the tree tops observed from the ground and confirmed with freshly cut pieces of the tree on top of the snow; 45° 33' 50.4" N, 084° 49' 37.2" W. The widest initial tree impact points were about 41.6 feet apart. The angle of descent through the tree to the resting position was between 14 and 20 degrees.

The main wreckage included most of the cockpit, the fuselage, empennage, horizontal stabilizer, a portion of the vertical stabilizer, the landing gear, and the engine. The fuselage and cockpit were wrapped around a tree and fractured from the nose of the airplane to the middle of the fuselage. The wings were detached from the fuselage and scattered in pieces throughout the wreckage path leading up to the main wreckage. The landing gear was located in the main wreckage and all three tires were no longer attached to their respective wheels. All three propeller blades remained attached to the propeller hub. The propeller blades were labeled A, B, and C for the purposes of the investigation. The blades exhibited s-bending, leading edge scoring, dents, and scratches. Blade A remained attached to the propeller hub, but was not fully intact and a small portion of it was found 200 feet north of the main wreckage. Blade B and C were intact and remained attached to the propeller hub.

Flight control continuity was confirmed for all flight controls. All flight control cables were fractured in overload. The flaps were found in the up position as confirmed by the position of the jack screw on the flap motor. The throttle quadrant received impact damage; the actual lever positions at the time of the accident could not be determined.

The instrument panel was mostly detached from the airplane and received impact damage. The instruments were scattered throughout the main wreckage. The attitude indicator gyro was examined and revealed rotational scoring on the inside of the gyro case and on the gyro.

Medical and Pathological Information

An autopsy and toxicology test was performed on the pilot at Spectrum Health, Grand Rapids, Michigan, on January 17, 2013. The cause of death was multiple blunt injuries and the manner of death was an accident. The toxicology results revealed no drugs detected. The FAA Civil Aeromedical Institute did not complete a Final Forensic Toxicology Fatal Accident Report because the specimens were not made available to them.

Tests and Research

Engine

The engine was examined and disassembled at the manufacturer's facility by the investigative party members. The group agreed that there was no evidence of preimpact mechanical malfunctions or failures that would have precluded normal operation.

Garmin GPSMAP 696

The unit is a battery-powered portable multi-function display and GPS receiver. It sustained impact damage to the screen and casing. A chip level recovery was performed on the memory chip located inside the unit. The data extracted included 157 sessions from February 24, 2012, through January 16, 2013, and consisted of 20,724 total data points. The accident flight consisted of 20 data points and began recording at 19:54:28 and ended at 19:57:58 EST on January 16, 2013.

Aircraft Performance GPS and Simulation Study

The National Transportation Safety Board's Office of Research and Engineering conducted an Aircraft

Performance GPS and Simulation Study. This study presents the results of using data from a portable GPS unit carried aboard the airplane, crash site information, and a simulator model of the Cessna 208B as the basis for a simulation that provides a physics-based estimate of the position and orientation of the airplane throughout the accident flight. The performance observations noted here are based on the results of this simulation.

The first GPS point showing the accident airplane clearly airborne was recorded at 19:57:19 as the airplane was climbing at 700 feet per minute (fpm) through about 730 feet MSL (14 feet AGL), on a track of about 223 degrees, and accelerating through 91 knots. The airplane continued accelerating while climbing at about 500 to 700 fpm to an altitude of about 960 feet MSL (240 feet AGL). The rate of climb then decayed, and after reaching a peak altitude of about 980 feet MSL (260 feet AGL) at 19:57:45, the airplane started to descend, and ultimately impacted terrain about 1 mile west-southwest of the departure end of the runway. The exact time of the impact is not known, but the simulation model flight time from the last recorded GPS position to the location and elevation of the impact site was estimated at 15 seconds, putting the time of impact at 19:58:13. The simulation rate of descent from 19:57:52 to the time of impact is about 650 to 680 fpm. The elapsed time from when the airplane became airborne at 19:57:19 to impact is 54 seconds.

The simulation indicated that the airplane was accelerating throughout the flight, from about 75 knots groundspeed shortly after liftoff to about 145 knots at impact. In addition, the airplane entered a right bank almost immediately after liftoff, and during the flight made a 42 degree right turn from the runway heading of 225 degrees to 267 degrees. The peak simulation bank angle during this turn was 12.3 degrees. At impact, the simulation indicated an airspeed of 156 knots, a pitch angle of negative 2 degrees, and a bank angle of 4.5 degrees.

Throughout the simulation, a constant power lever angle (PLA) setting of 72 percent was maintained. At the 72 percent PLA setting, the simulator reading results in a gas generator speed (Ng) of about 93 percent throughout the flight. This throttle setting resulted in the best match of the GPS and impact site data.

The load factors output by the simulation were used to compute "apparent" pitch and roll angles, defined as the angles that make the load factor vector in an unaccelerated reference system parallel (in airplane body axes) to the load factor vector in the actual accelerated reference system. These angles represent the attitude a pilot would "feel" the airplane to be in, based on a vestibular / kinesthetic perception of the components of the load factor vector in their own body coordinate system. Throughout the flight, the apparent roll angle was close to zero, and the apparent pitch angle was always greater than zero – even when the real pitch angle was less than zero.

Administrative Information

Investigator In Charge (IIC):	Lindberg, Joshua
Additional Participating Persons:	Cory Smith; Martinaire; Addison, TX Edward Gray; Martinaire; Addison, TX Alan Rusinowitz; Martinaire; Addison, TX Peter Basile; Cessna; Wichita, KS Marc Webber; FAA; Grand Rapids, MI Steve Betzer; FAA; Grand Rapids, MI Marc Gratton; Pratt & Whitney Canada; Montreal Claude Beaudry; Pratt & Whitney Canada; Montreal
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