Aviation Investigation Final Report

Location:	Canadensis, Pennsylvania	**Accident Number:**	ERA16FA143
Date & Time:	March 27, 2016, 11:47 Local	**Registration:**	N776JM
Aircraft:	Robinson R44	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of visual reference	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot was flying the helicopter from his home base to an airport that he was familiar with; he had flown the route multiple times in the past 2 years in the accident helicopter and in his airplane. Although he had an airplane instrument rating, he did not have a helicopter instrument rating, and the helicopter was not certificated for instrument flight. Before the flight, the pilot reviewed the weather conditions and forecast with his son, who was also a pilot; however, he did not receive an official weather briefing from a flight service station. Although instrument meteorological conditions prevailed for the area at the time the pilots reviewed the weather, the forecast was for conditions to improve by the time the pilot intended to arrive.

The flight departed in visual meteorological conditions and proceeded to the north. About 40 minutes into the flight, 10 miles south of the destination airport, the helicopter climbed sharply as it approached a ridgeline and entered the clouds. It then completed a 330° left turn, slowed, and climbed again, before reversing course and entering an uncontrolled descent into terrain. Postaccident examination of the helicopter revealed extensive impact damage, although there was no evidence of a preimpact failure or malfunction with the flight controls, drive line, structure, or the engine. The pilot was not instrument rated in helicopters, the helicopter was not equipped for flight in instrument meteorological conditions and the flight had inadvertently entered the clouds, all of which are conditions conducive to spatial disorientation. The vertical and horizontal maneuvering in the clouds was inconsistent with the intended rout of flight, and likely due to spatial disorientation.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's loss of control due to spatial disorientation, which occurred after ascending in order to clear rising terrain and inadvertently entering the clouds.

Findings

Personnel issues	Spatial disorientation - Pilot
Aircraft	Altitude - Not attained/maintained
Environmental issues	Clouds - Response/compensation
Environmental issues	Clouds - Effect on personnel
Environmental issues	Clouds - Effect on operation

Factual Information

History of Flight

Enroute	Altitude deviation
Enroute	Loss of visual reference (Defining event)
Enroute	Loss of control in flight
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On March 27, 2016, at 1147 eastern daylight time, a Robinson Helicopter R44, N776JM, was destroyed when it impacted terrain near Canadensis, Pennsylvania. The private pilot was fatally injured. The helicopter was registered to Sea Air Inc. and operated by the pilot under the provisions of Title 14 *Code of Federal Regulations* Part 91. Instrument meteorological conditions (IMC) prevailed, and no flight plan was filed for the personal flight. The flight departed Doylestown Airport (DYL), Doylestown, Pennsylvania, at 1109, destined for Mountain Bay Airpark (PA49), Greentown, Pennsylvania, about 60 miles to the north.

About the time of the accident, a witness was outside his home about 1/2-mile northwest of the accident site when he heard an aircraft engine overhead. The witness looked upward toward the sound, but the aircraft was obscured by clouds. He estimated the cloud height to be about 200 ft above the trees in his yard. The witness then heard a loud "boom," similar to a car striking a tree, followed by another "boom" a few seconds later.

The helicopter was equipped with an on-board GPS; review of the recorded data revealed that, over the last 10 minutes of flight, the helicopter's altitude gradually increased. The increase in altitude corresponded with rising terrain. As the helicopter approached the crest of a ridge, the GPS altitude increased sharply to about 2,200 ft mean sea level (msl), or about 200-300 ft above ground level (agl) in the area of the ridge. At the time, the reported cloud ceiling was also about 2,200 ft msl. The yellow arrows in Figures 1 and 2 indicate the climb and location of the ridge.

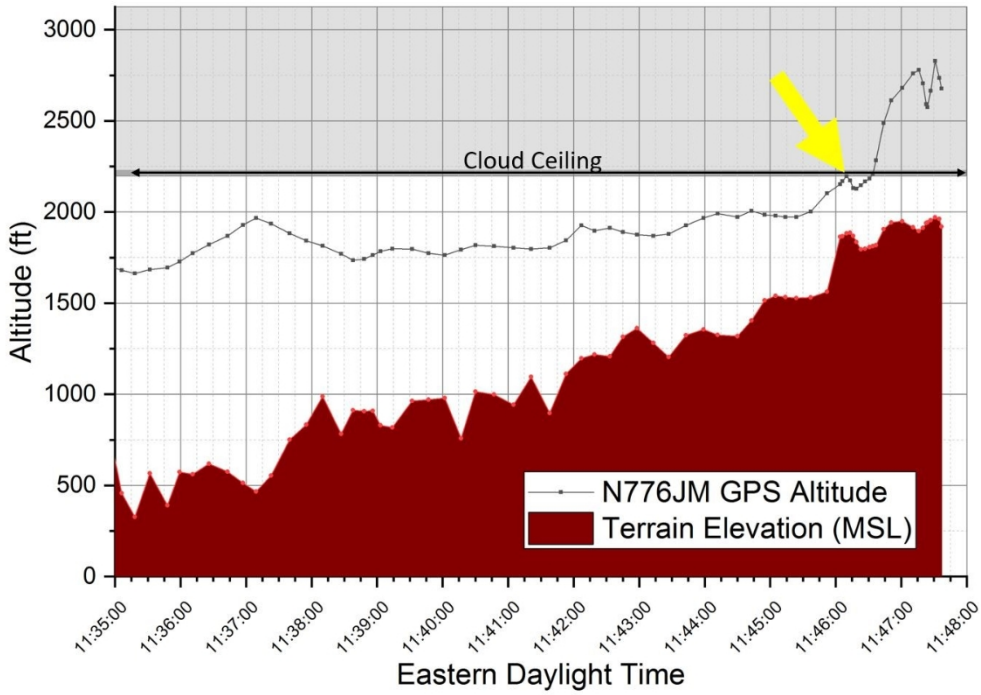

Figure 1. Altitude and Terrain Elevation

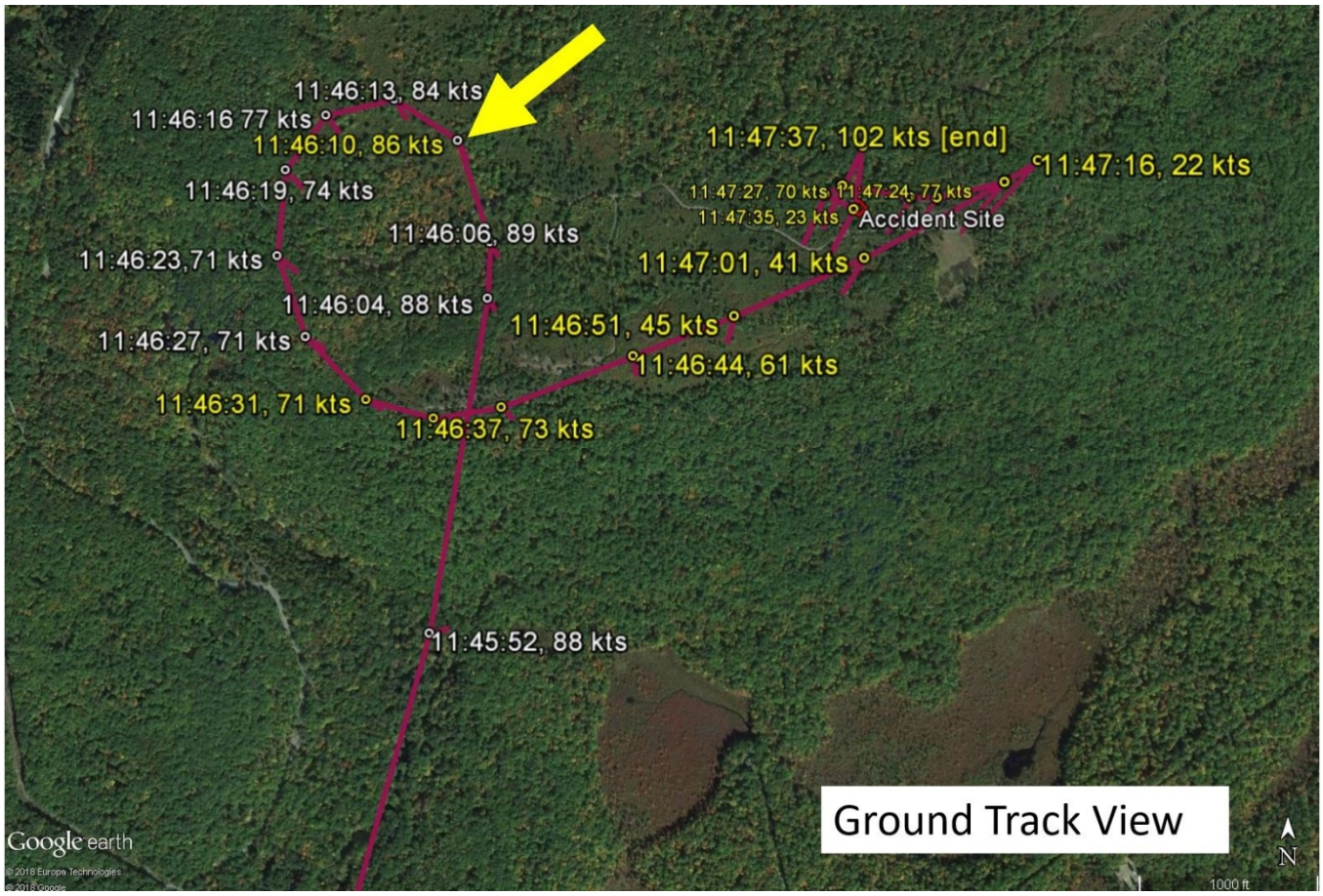

Figure 2. Ground Track

The helicopter then descended slightly as it began a left 330° turn, then climbed again; the GPS altitude indicated that the helicopter was above the cloud ceiling (as depicted by the yellow data points in Figure 2). The helicopter then flew northwest for about 40 seconds as it continued to climb, while the ground speed decreased from about 70 knots to about 20 knots. The helicopter then reversed course briefly, and then made several changes in track direction and altitude, before making a left 270° turn just before the last data point, which was about 135 ft north of the accident site at a GPS altitude of 2,678 ft msl, which was about 800 ft agl.

Pilot Information

Certificate:	Private	**Age:**	81,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	March 10, 2016
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	October 10, 2015
Flight Time:	2330 hours (Total, all aircraft), 345 hours (Total, this make and model), 2 hours (Last 90 days, all aircraft), 2 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

According to Federal Aviation Administration (FAA) records, the pilot held a private pilot certificate with ratings for airplane single-engine land, rotorcraft helicopter, and instrument airplane. His most recent FAA third-class medical certificate was issued March 10, 2016. A review of the pilot's logbooks revealed that he had a total of 2,333 hours of flight experience, including 449 hours in rotorcraft, of which 345 hours were in the same make and model as the accident helicopter. He had logged 7 hours in the 3 months before the accident, 5 of which were in the accident helicopter. In the 24 months preceding the accident, he had flown from DYL to PA49 17 times in the accident helicopter and 7 times in his airplane. He had not logged any flight experience in actual or simulated instrument meteorological conditions during that period.

Aircraft and Owner/Operator Information

Aircraft Make:	Robinson	**Registration:**	N776JM
Model/Series:	R44	**Aircraft Category:**	Helicopter
Year of Manufacture:	2007	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	1738
Landing Gear Type:	N/A; Skid	**Seats:**	4
Date/Type of Last Inspection:	July 1, 2015 100 hour	**Certified Max Gross Wt.:**	2400 lbs
Time Since Last Inspection:	35 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	629.1 Hrs as of last inspection	**Engine Manufacturer:**	LYCOMING
ELT:	Installed	**Engine Model/Series:**	O-540-F1B5
Registered Owner:	On file	**Rated Power:**	235 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The four-seat, single-main-rotor, single-engine helicopter, serial number 1738, was manufactured in 2007. The helicopter was powered by a 260-horsepower Lycoming O-540-F1B5 series engine. The helicopter was not certificated for instrument flight rules operation.

Review of maintenance records revealed that the most recent 100-hour inspection was completed on July 1, 2015. At the time of the inspection, the airframe and engine had been operated for about 629 hours since new. The helicopter's total time on the day of the accident could not be determined due to impact and fire damage; however, the pilot had logged about 34 hours in the helicopter since the inspection.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	MPO,1916 ft msl	**Distance from Accident Site:**	10 Nautical Miles
Observation Time:	11:53 Local	**Direction from Accident Site:**	227°
Lowest Cloud Condition:		**Visibility**	7 miles
Lowest Ceiling:	Overcast / 300 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	140°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.3 inches Hg	**Temperature/Dew Point:**	4°C / 3°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	DOYLESTOWN, PA (DYL)	**Type of Flight Plan Filed:**	None
Destination:	GREENTOWN, PA (PA49)	**Type of Clearance:**	None
Departure Time:	11:09 Local	**Type of Airspace:**	

The closest reporting weather station to the accident site, Pocono Mountains Municipal Airport, Mount Pocono, Pennsylvania, was located about 10 miles southwest of the accident site at an elevation of 1,915 ft. At 1153, the reported weather included an overcast ceiling at 300 ft agl with 7 statute miles of visibility. The wind was from 140° at 7 knots, the temperature was 4°C, the dew point was 3°C, and the altimeter setting was 30.31 inches of mercury. The station reported an overcast ceiling height of 200 ft agl from 0953 to 1118.

A weather computer model balloon sounding and satellite weather data for the accident area about 1100 showed clouds likely from near the surface through 4,000 ft msl. Weather radar animation for the accident area at the time of the accident showed no precipitation.

The area forecast issued at 0445 and valid at the time of the helicopter's departure forecasted an overcast ceiling between 1,500 and 2,000 ft msl with cloud tops between 3,000 and 4,000 ft msl. However, the 0445 area forecast showed cloud ceiling conditions improving between 0800 and 1100, with the forecast expecting broken to scattered clouds between 1,500 and 2,500 ft msl. The forecast showed continued improving conditions between 1100 and 1400, with scattered clouds at 2,500 ft msl, a broken ceiling between 3,500 and 5,000 ft msl, and cloud tops at 6,000 ft msl.

Between 0827 and 1045 a separate AIRMET was in effect for the accident area; it warned of mountain obscuration and IFR conditions due to clouds, fog, and mist along the flight route and at the accident site. An AIRMET issued at 1045 indicated mountain obscuration along the flight route due to clouds, precipitation, and mist was in effect for the accident area at the time of the accident.

The weather conditions reported at DYL at an elevation of 394 ft msl, at 1054, which was about 15 minutes before the pilot departed were: variable wind at 3 knots, 10 statute miles visibility, an overcast ceiling at 1,700 ft agl, temperature 7°C, dew point 4°C.

According to the pilot's son, who was also a pilot, he had reviewed the weather conditions and forecast with the pilot on the morning of the accident. They were both aware of the low ceilings and forecast of improving conditions. They were satisfied that the conditions should be suitable for the flight. The pilot did not receive a weather briefing from a flight service station.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	Unknown
Total Injuries:	1 Fatal	**Latitude, Longitude:**	41.250556,-75.219169

The helicopter impacted a wooded area about 100 yards north of an east-west oriented ridgeline, about 20 ft below the top of the ridge at an elevation of 2,000 ft msl. The wreckage path proceeded downhill along a heading of about 325° magnetic and was about 175 ft long. All major components of the helicopter were located at the accident site. The wreckage was significantly fragmented and partially consumed by a postcrash fire. Continuity from the controls to the main and tail rotor systems could not be confirmed due to impact and fire damage, however, all control rod ends were found in the wreckage path.

The throttle control linkages sustained impact and thermal damage. The linkage on the collective pitch control assembly was found in the full open position. The rod end at the carburetor control arm was fractured. The control arm was found beyond the full open position and the arm stop was separated from the carburetor. The mixture control knob and the control cable end (separated from the control arm) were found in the full rich position. The carburetor heat control linkage and slider valve were found in the on position.

The empennage, tail rotor gearbox, and one tail rotor blade that was fractured near its root, were among the debris found closest to the initial impact area. The tail rotor gearbox rotated freely by hand. Both tail rotor blades exhibited leaded edge gouging. The engine, main rotor gearbox, and tailboom, were all separated from the fuselage and located along the wreckage path. The main rotor driveshaft was fracture-separated at the main rotor hub, consistent with overload. The driveshaft rotated freely by hand. Both main rotor blades remained attached to the hub and were significantly damaged by impact and fire.

The fuselage components were fragmented and thermally damaged. All of the cockpit flight controls were found in the debris.

Examination of the engine revealed fire and impact damage. The crankshaft was rotated by hand, and continuity was confirmed from the powertrain through the valvetrain to the accessory section. Valve continuity to the number 5 cylinder could not be confirmed due to impact damage to each pushrod. Compression was confirmed in all cylinders using thumb compression. Both magnetos were damaged by impact and fire and could not be actuated to produce spark. The spark plugs were intact and appeared consistent with the "worn out – normal" depiction on the Champion Check-A-Plug chart.

Flight recorders

The helicopter was not equipped with a flight recorder nor was it required to be. A portable GPS receiver was recovered from the accident site and forwarded to the NTSB Vehicle Recorder laboratory for examination. It captured GPS position and time data for the accident flight and several previous flights. More information is available in the public docket for this investigation.

Medical and Pathological Information

Forensic Pathology Associates, Allentown, Pennsylvania, conducted an autopsy on the pilot. The cause of death was determined to be "multiple blunt force injuries."

The FAA Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, conducted toxicological testing of specimens from the pilot. The results were positive for diltiazem and metoprolol, which are used to control blood pressure. Neither are considered to be impairing and the pilot had reported them during his most recent medical exam. The results were positive for ethanol that was consistent with postmortem production.

The pilot's family reported that on the morning of the accident, the pilot woke up dizzy with an elevated heart rate, but he felt well before the flight.

Additional Information

Spatial Disorientation

The FAA Civil Aeromedical Institute's publication, "Introduction to Aviation Physiology," defines spatial disorientation as a loss of proper bearings or a state of mental confusion as to position, location, or movement relative to the position of the earth. Factors contributing to spatial disorientation include changes in acceleration, flight in IMC, frequent transfer between visual meteorological conditions (VMC) and IMC, and unperceived changes in aircraft attitude. The publication states that pilots flying in IMC are more susceptible than usual to the stresses of flight, such as fatigue and anxiety, and any event that produces an emotional upset is likely to disrupt the pilot's mental processes, making them more vulnerable to illusions and false sensations.

The FAA's Airplane Flying Handbook (FAA-H-8083-3A) describes some hazards associated with flying when the ground or horizon are obscured. The handbook states, in part: "The vestibular sense (motion sensing by the inner ear) in particular tends to confuse the pilot. Because of inertia, the sensory areas of the inner ear cannot detect slight changes in the attitude of the airplane, nor can they accurately sense attitude changes that occur at a uniform rate over a period of time. On the other hand, false sensations are often generated; leading the pilot to believe the attitude of the airplane has changed when in fact, it has not. These false sensations result in the pilot experiencing spatial disorientation."

Administrative Information

Investigator In Charge (IIC):	Brazy, Douglass
Additional Participating Persons:	Arthur Strauss; FAA/FSDO ; Allentown, PA Thom Webster; Robinson Helicopter ; Torrance, CA Judson Rupert; Lycoming Engines; Williamsport, PA
Original Publish Date:	May 9, 2018
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=92898