

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, DC 20594

UAS Aerial Imagery Factual Report

2/3/2020

A. ACCIDENT ERA18FA264

Location: Greenville, SC
Date: September 27, 2018
Time: 1346 EDT
Event: N114TD, Dassault Falcon 50

B. PERSONNEL

UAS RPIC: Cathy Gagne
National Transportation Safety Board
Washington, D.C.

UAS VO: Mike Bauer (Day 1)
National Transportation Safety Board
Washington D.C.

Civil Air Patrol (CAP), Deputy Commander (Day 2)¹
Greenville Composite Squadron
Greenville, SC

C. ACCIDENT SUMMARY

On September 27, 2018, about 1346 eastern daylight time, a Dassault Falcon 50 business jet, N114TD, operated by Air American Flight Services, Inc., was substantially damaged when it overran runway 19 at the Greenville Downtown Airport (GMU), Greenville, South Carolina. The airline transport pilot seated in the left cockpit seat and private pilot seated in the right cockpit seat were fatally injured, and the two passengers received serious injuries. Visual meteorological conditions prevailed, and an instrument flight rules flight plan was filed for the flight that departed St. Petersburg-Clearwater International Airport (PIE), St. Petersburg-Clearwater, Florida, destined for GMU. The personal flight was conducted under the provisions of Title 14 *Code of Federal Regulations (CFR)* Part 91.

¹ Prior to Day 2 operations, the RPIC met in an airport conference room with the CAP visual observer (VO) and briefed the training requirements for VO in accordance with *NTSB UAS Program Standard Operating Procedures* and verified understanding for compliance. Briefing included reviewing the SGI issued for the operation, particular the statement that “ALL UAS OPERATIONS MUST GIVE WAY TO MANNED AIRCRAFT.”

D. DETAILS OF IMAGERY

1. Equipment and Procedures

Equipment

Mapping and viewpoint flights of the accident area and runway 19 were conducted on September 28 and 29, 2018, using the NTSB DJI Phantom 4 Professional. The drone is equipped with a dual GPS/GLONASS receiver, which provides georeferenced information on all still photos, and an FC6310 camera with the Sony Exmor 1” CMOS sensor with a focal length of 8.8 mm. Still photo resolution is 20 megapixels in JPG or RAW format.

Ground control points (GCP) and checkpoints were taken with a Trimble GEO7X differential GPS (DGPS) receiver in the accident area.

Procedures

The accident site was generally southeast of the departure end of runway 19 at the edge of the airport property with the forward section of the fuselage resting on Airport Road, the adjacent public roadway. All flights were operated within the KGMU Class D airspace under the provisions of 14 *CFR* Part 107 with a Special Governmental Interest (SGI) authorization.

Potential hazards to flight operations were the proximity to the wreckage of the approach lighting towers for runway 1, the proximity of personnel on the roadway prior to wreckage recovery, and the presence of manned air traffic and surface vehicles and personnel during active airport operations. Mitigations included: 1) the use of the visual observer (VO) to assist with visually verifying clearance from the lighting towers, roadway personnel, manned air traffic, and ground vehicles and personnel on the airport; and 2) remote pilot in command (RPIC) prior coordination and constant radio contact with GMT air traffic control tower (ATCT) personnel to obtain clearances to access active airport surface areas, launch drone operations over specified areas, and land upon request to allow for manned aircraft arrivals and departures.

To obtain the imagery for creating orthomosaic maps, the small unmanned aircraft system (sUAS) was flown 1) over the wreckage in an overlapping double grid (flown at 120 ft above the wreckage site elevation of about 956 ft msl) and an orbit flight (flown at 50 ft above the wreckage site elevation); 2) over the departure end of runway 19, the grassy plateau at the end of the runway, and the wreckage in an overlapping double grid (flown at 120 ft above the runway elevation of about 995 ft msl); and 3) over the entire length of runway 19 in a single grid (flown at 120 ft above runway elevation). Total flight time was about 45 minutes on Day 1, and 1 hour 50 minutes on Day 2. Total area covered was about 76 acres.

Processing

Geo-referenced still imagery was processed using Pix4D photogrammetry software to produce both a low-resolution and a high-resolution orthomosaic map. Relative accuracy (within the map) for the high-resolution orthomosaic was calculated at 0.78 inch, twice the average ground sampling distance.

DGPS data was used to correct for any UAS elevation data errors and provide positional data for 26 GCPs and 43 checkpoints.² DGPS data was corrected using the Continuously Operating Reference Station (CORS) at Greer, South Carolina (SCGP). Positional accuracy (when compared to features outside the 3D point cloud) was calculated at 4 inches horizontally and 4 inches vertically.

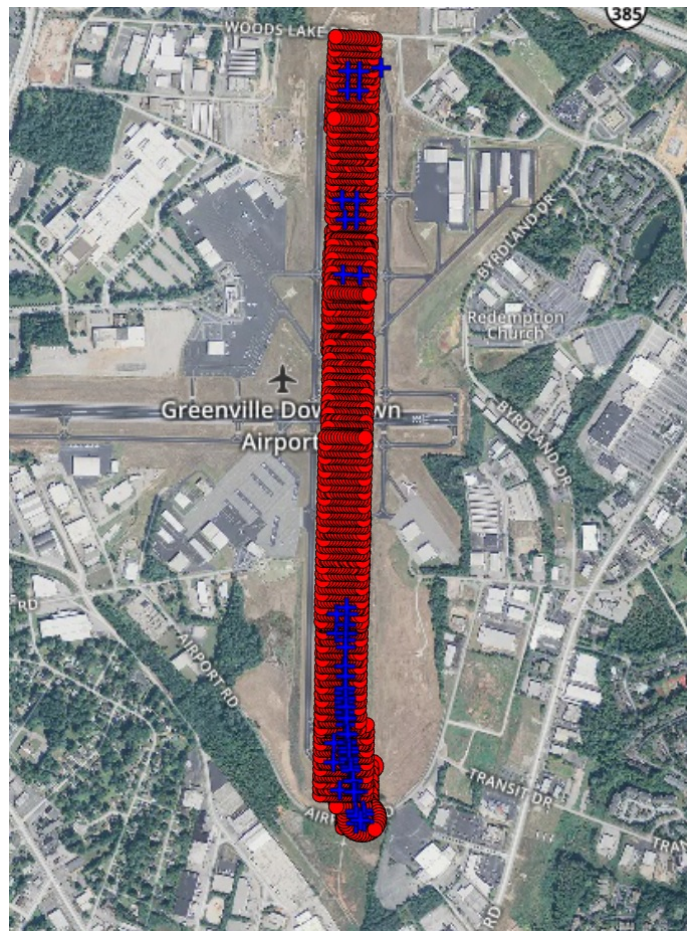


Figure 1. Screen capture from Pix4D showing area mapped. Red dots show location of images taken, blue crosses show location of recorded GCPs and checkpoints.

² Light-colored parallel tire marks on the runway and tire marks in the grass were marked with paint and/or orange cones by the City of Greenville Police Department Collision Reconstruction Unit. NTSB personnel used the DGSP to record checkpoints at several of the paint markers. The cones are not present in some images (airport personnel moved them when the runway was reopened).

2. Imagery products

The sUAS gathered 2,635 high-resolution photos (capturing the accident site and the entire length of runway 19) for use in developing imagery products. Images created from select source photographs and the orthomosaic maps are included below. An orthomosaic of the accident site area was exported in Google Earth tiles .kmz file format and used for describing general distances and orientation in select figures below.



Figure 2. Wreckage. View looking generally west.



Figure 3. Wreckage. Tire tracks across the grassy plateau of the runway safety area (RSA) are marked with orange cones. View looking generally north.



Figure 4. Light-colored parallel tire marks on the runway and tire marks in the grass with paint markers (annotated with yellow circles) exiting the east side of the runway 19 shoulder at an area adjacent to the runway 1 threshold marking stripes. Inset shows annotated detail of one paint marker and one set of parallel tire marks.



Figure 5. Screen capture from Pix4D point cloud. Green markers indicate location of GCPs, blue markers indicate location of checkpoints (paint markers on tire marks).



Figure 6. Orthomosaic in Google Earth showing wreckage came to rest on an orientation of about 168° (true) and about 190 ft from the edge of the grassy plateau part of the RSA above. Yellow line also shows approximate direction of travel. (Line aligned with fuselage also generally aligns visually with ground scars at top of plateau and location of excursion from runway shoulder.)



Figure 7. Orthomosaic map in Google Earth showing wreckage came to rest about 430 ft from the end of runway 19. (Note: Yellow line shows distance to end of runway at centerline, not airplane direction of travel.)



Figure 8. Orthomosaic map in Google Earth with yellow line showing the length of the grassy plateau part of the RSA is about 220 ft.

3.0 Attachment

Attachment 1. Orthomosaic map in Google Earth .kmz format

Catherine Gagne, RPIC