

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

UAS Aerial Imagery Report

10/5/2019

A. ACCIDENT CEN19MA312

Location: Monclova, Oh.
Date: Sept 11, 2019
Time: 0239 Local Time (EDT)
Event: Impact with trees and terrain

B. PERSONNEL

UAS RPIC: Bill English
NTSB UAS Program Lead
Washington DC

UAS VO Aaron Sauer
CEN Region

C. ACCIDENT SUMMARY

On September 11, 2019, at 0239 eastern daylight time, a Convair 440 airplane, N24DR, impacted trees and terrain while on final approach to runway 25 at the Toledo Express Airport (TOL). The accident site was located about 1/2-mile from the runway arrival threshold in Monclova, Ohio. Both pilots were fatally injured. The airplane was destroyed by impact forces and a postimpact fire. The airplane was registered to a private individual and operated by Ferreteria E Implementos San Francisco under Title 14 Code of Federal Regulations Part 125 as a non-scheduled cargo flight. Night visual meteorological conditions prevailed, and the flight was being operated on an instrument flight rules flight plan. The flight originated from the Millington-Memphis Airport (NQA), Millington, Tennessee, at 2314 central daylight time and was destined for TOL.

D. DETAILS OF IMAGERY

1.0 Equipment and Procedures

Equipment

Flights to photo-document and map the area of the crash, and to assess night visual appearance were conducted on September 11 and 12, 2019, using one of the NTSB DJI Phantom 4 Advanced small unmanned aircraft systems (sUAS, or drone). The drone is

equipped with a dual GPS/GLONASS receiver which provides georeference information on all still photos. The drone is equipped with an FC6310 camera using 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, the camera is capable of video resolution of 4K HD up to 120 frames per second.

Ground control points (GCP) were taken with a Trimble GEO7X differential GPS receiver.

Procedures

The accident site was in the parking lot of a heavy truck maintenance facility, adjoining a small area of trees to the east. The east edge of the tree area was adjacent to a parking lot of a Army Reserve Armory. The wreckage area was in Class C airspace, approximately 3,350 feet from the approach end of runway 25 at KTOL. There were no significant terrain or obstruction hazards. Environmental hazards in the area were soot from the post-crash fire and wreckage from the airplane and damaged trucks in the repair facility. The flight was conducted under 14 CFR 107 with Special Government Interest airspace approval and 107.29 night waiver. Weather conditions were generally VFR with passing rain showers.

On the afternoon of Sept 11, the drone was flown in a nadir single grid pattern over the main wreckage site to build a quick overview map (see Processing section). A daylight scout sortie as required prior to night operations was conducted later that afternoon. Three sorties were flown between 4:30 and 5:00 am on Sept 12 to document the visual appearance of the approach to the airport and accident area under similar conditions to the accident. Still photos were taken at various exposure and shutter speeds to duplicate the visual appearance as much as practical. Video was taken at 1080p/30 fps for maximum similarity to normal human visual appearance.

During daylight on Sept 12, the drone was operated over the wreckage and tree area capturing still images to create a 3D orthomosaic map and point cloud of the wreckage and tree strike witness marks. Three double grids at 150 feet covered the entire area, two flights at 100 feet were used for further detail in the main wreckage and the tree swath, and a set of oblique photos at 75, 50, and 25 feet was taken of an area of interest in the main wreckage. Additional still photos and video for overview purposes and along the flight path were taken. Approximately 1500 high resolution photos and videos were gathered.

Total mission time including set-up, gathering ground control points, flights, and initial processing was 10 hours over the 2 day period.

Processing

The initial map of the area was processed using the beta version of Pix4D REACT software, to create a rapid low-resolution orthomosaic of the main wreckage area for on-scene

visualization and reference.

The double grid photos were processed using Pix4D to create a 3D point cloud and orthomosaic of the entire scene beginning east of the initial tree strikes in the Armory parking lot and extending west across the wreckage area. The orthomosaic map was output reference the WGS84/UTM zone 17N for best correlation with aeronautical data.

A detailed 3D model of the wreckage area using a double grid and oblique set of photos was processed in order to show more detail of the airplane and to measure prop slash marks on a damaged truck.

The ground control points (GCPs) taken on scene were corrected using the Continuously Operating Reference Station (CORS) at the Ohio DOT Lucas County Engineers Office. The correction report indicated an accuracy of 5cm with 95% confidence. GCPs were exported in WGS84/EGM96 datum.

2.0 Imagery products

Photographs and processed imagery are included below. Google Earth kmz tiles, orthomosaic geo-tiff, and point cloud in las format are included in the docket.

Figure 1 depicts the overall accident area. The last radar target was about 140 feet above ground level, the initial tree strikes were between 80-100 feet above ground level. The westernmost building of the Armory is visible at the bottom of the map. A general rightward curve was noticable in the swath through the trees and the ground scar. Final orientation was about 285 degrees true, 3,340 feet from the runway threshold.



Figure 1 – Google Earth orthomosaic

Figure 2 was taken from 300 feet above the tree swath area, note PAPI lights.



Figure 2 – Night view of accident site and runway 25 approx 300 feet agl

Figure 3 depicts the view toward the runway from a position between the last two radar targets. Radar data obtained by the NTSB ATC investigator indicated the airplane was about 140 feet above the runway threshold at this point (about 200 feet lower than the photo).



Figure 3 – View from east of Armory at 360 feet agl, note Armory lights; PAPI and approach lights are visible.

The UAS team observed that the view of the approach lights began to be obscured by trees when the camera position descended below 100 feet over the Armory building, or 80 feet over the parking lot. Figure 4 was taken from 200 feet above the Armory building – the RAIL lights began to be obscured, note the traffic on the interstate is also obscured.



Figure 4 – Night view of accident site over Armory approx 200 feet

For an aid to visualization, Figure 5 is a daylight view of the approach area from over the tree swath at approximately 300 feet, (similar to Figure 2.)



Figure 5 - Daytime overview looking toward accident site and runway 25 approx 300 feet agl

Figure 6 is an overview of the ground scar leading to the main wreckage area. The runway threshold is in the background. Note the rightward curve of the scar and orientation.



Figure 6 – Daylight view along tree swath toward wreckage, note runway threshold at top left.

Figure 7 is a photograph from approximately 80 feet above the parking lot, aligned with the initial tree strikes – note the airport is partially visible, the interstate is obscured.



Figure 7 – Initial tree impact at Armory parking lot, approx 470 feet to main wreckage site.

A 3D point cloud model of the entire scene was constructed and used to make measurements of the angles of impact. Figure 8 depicts a snapshot of three sequential angular measurements between tree strikes perpendicular to the direction of travel – consistent with a right bank angle of the airplane. The initial angle is 27 degrees, progressively steepening to 48.5 degrees, and 71 degrees just after the location of a large tree break and the separated horizontal stabilizer.

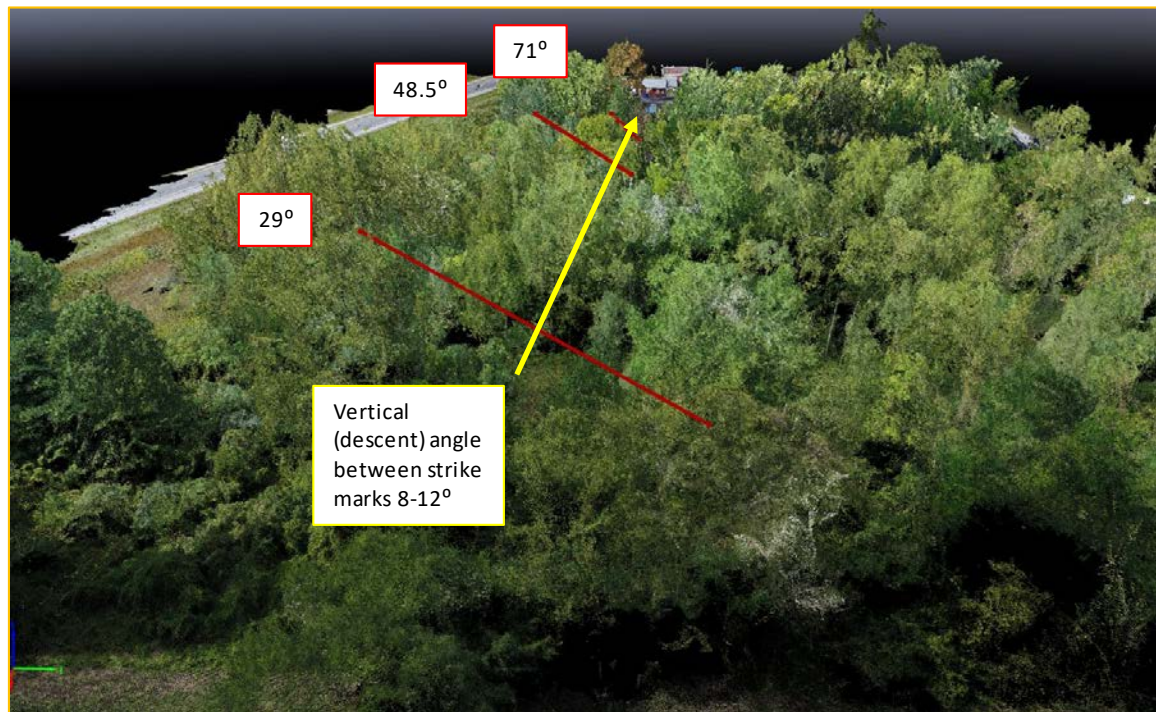


Figure 8 – Measurements of tree strike angles.

Google Earth tools were applied to the orthomosaic map to estimate the radius of the turn visible in the tree swath. Figure 9 indicates the radius is about 1,241 feet. Applying the standard formula $R = v^2 / 11.26 * \tan \text{BankAngle}$ results in 84 knots groundspeed, consistent with ATC radar data.



Figure 9 – Measurement of turn radius.

Proceeding to the main wreckage area, a detailed point cloud of the airplane and damaged trucks was created with the low altitude double grid, and oblique imagery around a trailer that exhibited prop slash evidence. The spacing between slash marks was measured at 35.5 inches increasing to 42 inches (Figure 10), however the team noted that there was ground evidence that the trailer moved during the impact sequence, likely making the slash marks less usable for RPM or speed estimation.

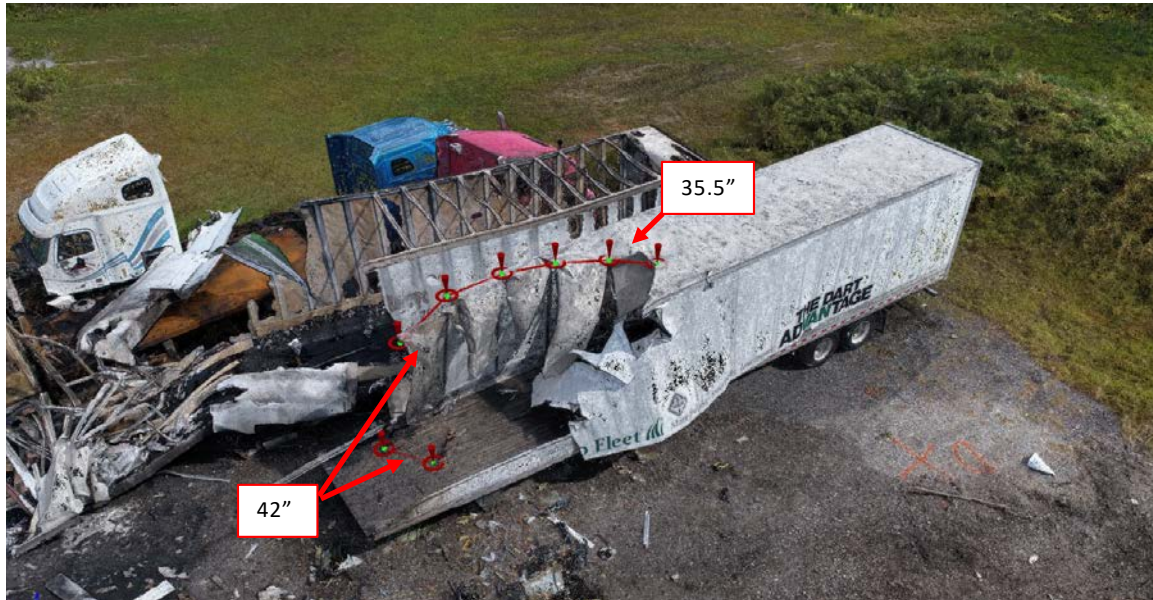


Figure 10 – Measurement of prop slash marks.

The detailed point cloud is included in the docket for this investigation, enabling measurements between any points in the main wreckage area. A snapshot view of the point cloud is shown in Figure 11.



Figure 11 – Point cloud of main wreckage.

The orthomosaic map is included in the docket, enabling visualization in Google Earth or GIS software. Figure 12 is an exemplar snapshot of the map in Google Earth showing a measurement of the distance from the left wingtip to the centerline of the main wreckage.

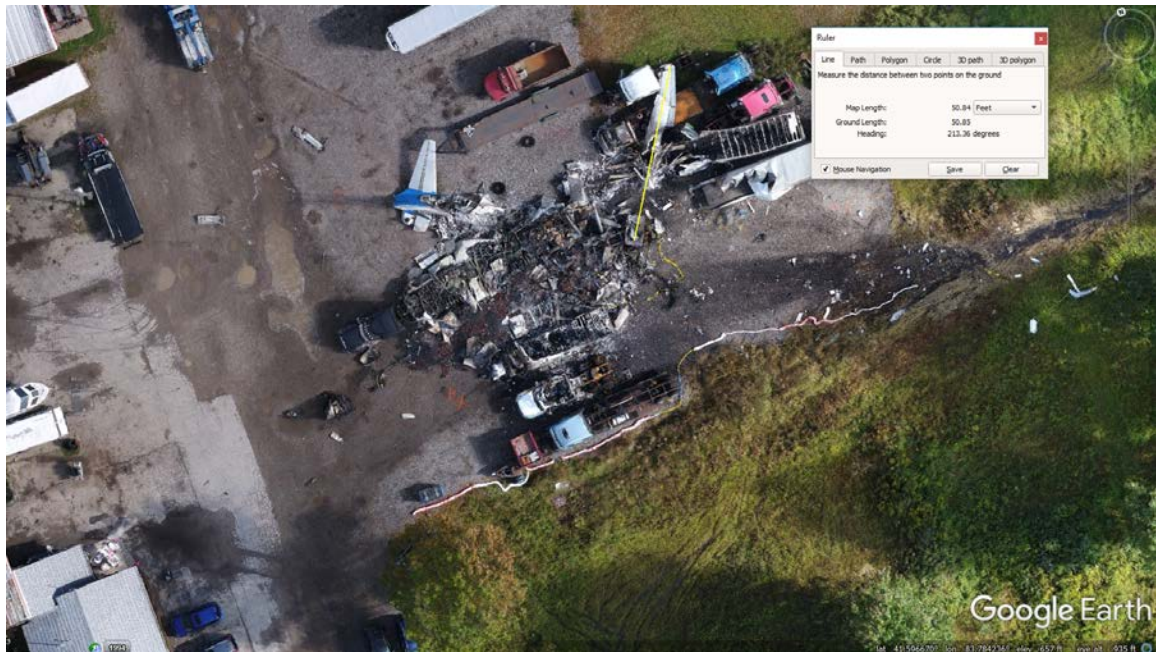


Figure 12 – Exemplar use of Google Earth map.

3.0 Attachments:

1. Google Earth kmz
2. Orthomosaic geo-tiff
3. Overall point cloud laz
4. Detailed point cloud laz