**NATIONAL TRANSPORTATION SAFETY BOARD**
Office of Aviation Safety
Washington, D.C. 20594

**UAS Aerial Imagery Report**

8/21/2019

## A. ACCIDENT HWY19MH001

| | |
|---|---|
| Location: | Schoharie, NY. |
| Date: | October 6, 2018 |
| Time: | 1:55 p.m. Local Time (EDT) |
| Event: | Stretch Limousine collision with pedestrians, parked vehicle, and off roadway crash |

## B. PERSONNEL

| | |
|---|---|
| UAS RPIC: | Bill English<br>National Transportation Safety Board<br>Washington, D.C. |

## C. ACCIDENT SUMMARY

A summary of this accident is contained the docket.

## D. DETAILS OF IMAGERY

### 1.0 Equipment and Procedures

**Equipment**

Flights to photo-document, video, and map the area of the crash were conducted on October 8, 2018, using one of the NTSB DJI Phantom 4 Professional 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 along the roadway approaching the accident scene, and in the vicinity of the site.

**Procedures**

The accident area was at the intersection of State Highways 30 and 30A northeast of the town of Schoharie, in Class G airspace. Flights were conducted under the provisions of 14 CFR Part 107. The accident area was in a rural to suburban area with some tree cover. Weather was VFR with light winds and overcast conditions. No significant hazards to flight were in the area.

The sUAS was flown in an overlapping double grid over the main crash site and approach to the intersection, with a viewpoint video from the final approach to the intersection. Corridor grid flights were conducted along Highway 30 to the crest of the hill in order to map the slope of the approach to the accident site. Approximately 1200 high resolution photos and videos were gathered.

## 2.0 Processing and Products

### Processing

The GCPs were processed using the Cobleskill NY, Continuously Operating Reference Station (CORS) resulting in a positional accuracy of approximately 10 cm.

Still imagery was processed using Pix4D photogrammetry software to create a 3D point cloud and orthomosaic map outputs. Relative accuracy (within the map) was calculated at 0.98 inches, (twice the average ground sample distance.)

The orthomosaic output from Pix4D includes a digital terrain map (DTM). The DTM resolution was reduced to 20 cm in order to minimize noise, and imported into ArcGIS software. The ArcGIS slope analysis tool was applied to the DTM to produce a layer depicting the local slope as a percent grade.

### Imagery products

Select source photos and snapshots from the processed products are shown below. The point cloud, orthomosaic, reduced DTM, and ArcGIS map file are included in the docket.

The sequence of photos and graphics below begins with general overviews of the accident area, steps through the process to determine the gradient of the road, and finally a still reference to a "fly-though" video of the 3D point cloud.

Figure 1 is a sample photograph of the area where the limousine came to rest (it had been removed at the time of the photo.)


**Figure 1 – Overhead of crash area**

Figure 2 is a still frame from an overview video looking in the direction of flight toward the final resting point.

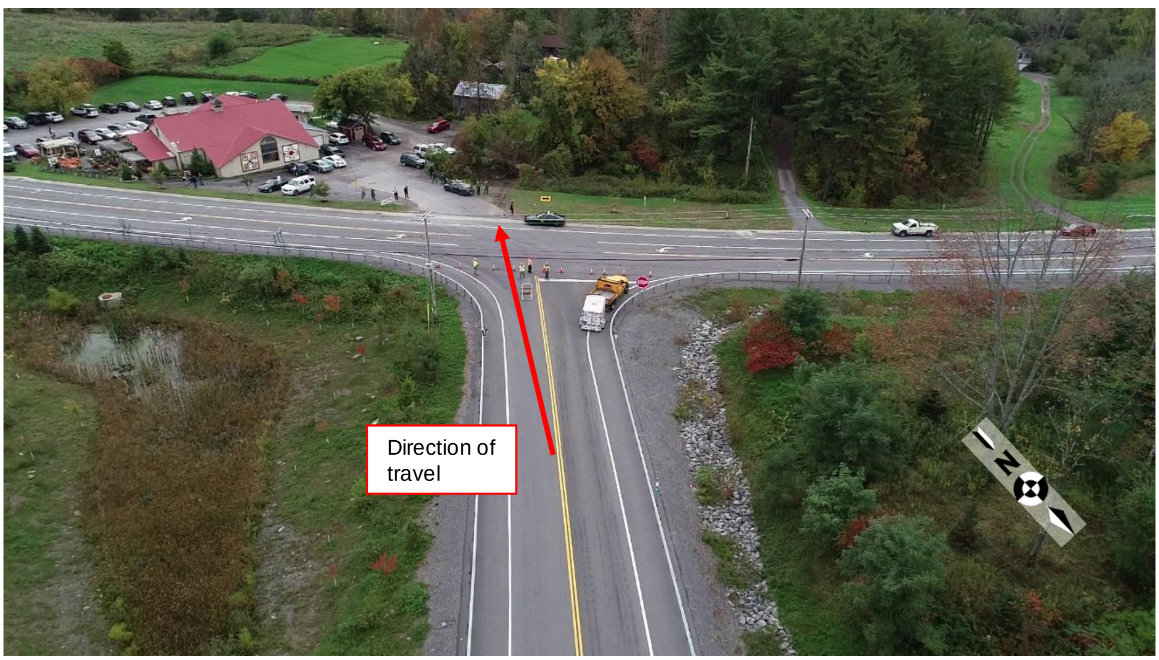


**Figure 2 – Video snapshot view toward crash site**

Figure 3 is an excerpt from the orthomosaic map overlaid on Google Earth, with select measurements indicated. A kmz file of the map is in the docket, and can be zoomed and manipulated.

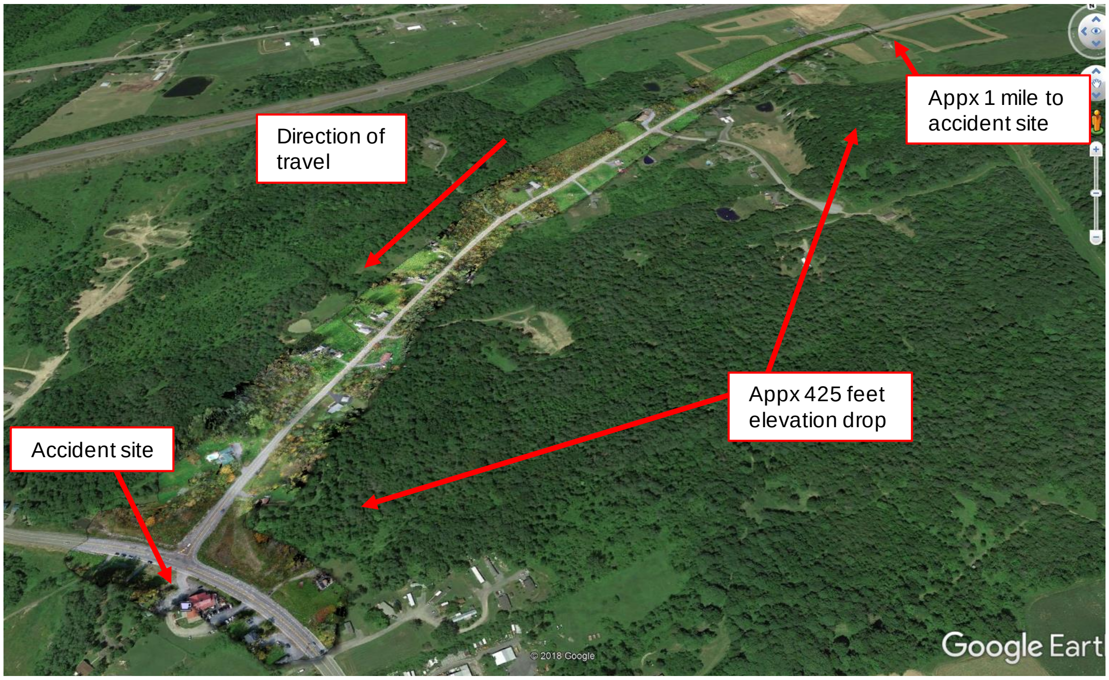


**Figure 3 – Orthomosaic overlaid on Google Earth**

Figure 4 is a snapshot of the 3D point cloud, which is the basis for the orthomosaic and GIS products. The change in elevation is evident. The point cloud in xyz format is included in the docket.

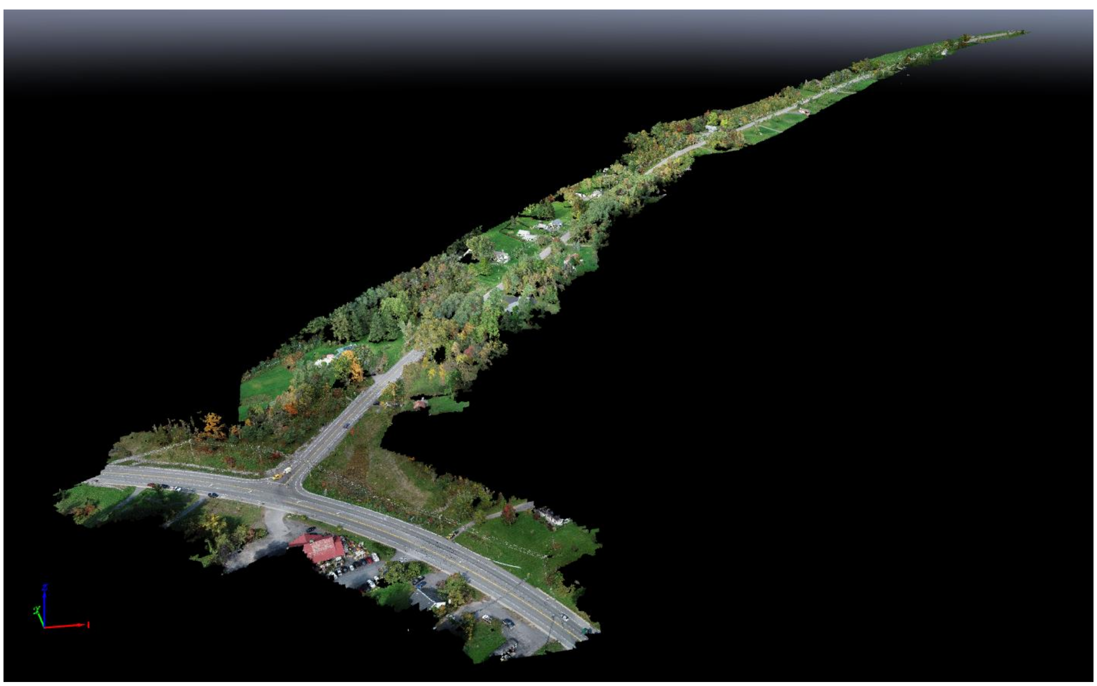

**Figure 4 – Snapshot of 3D point cloud with no basemap, showing elevation change**

Figure 5 consists of two snapshots showing the interim point cloud classification, which separates high vegetation, buidlings and other objects from ground, and in the right graphic, road surface. Classification enables the creation of a digital terrain model (DTM), eliminating noise from the height of objects such as houses and cars.

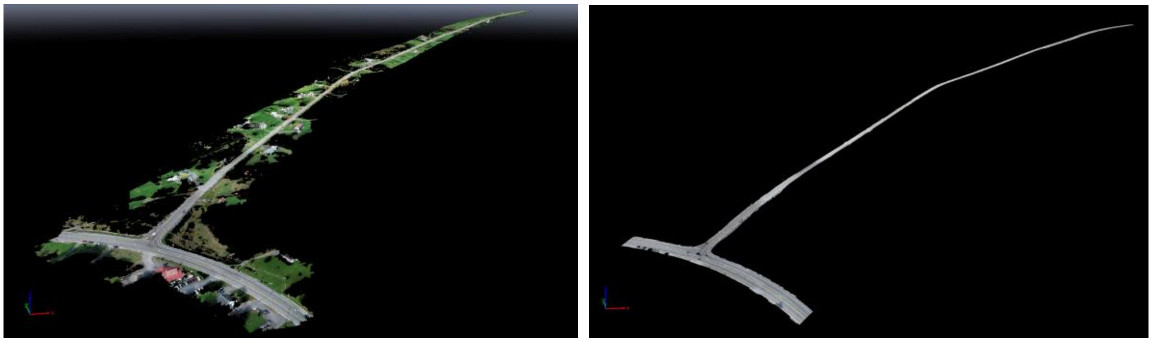

**Figure 5 – Snapshots of point cloud classification, left graphic removes high vegetation, right graphic is only "road" surface classification, to be used as the source for digital terrain model.**

Figure 6 depicts the digital terrain model overlaid on a topographical chart basemap in ArcGIS. The color gradient and contours depict the height above sea level in meters.

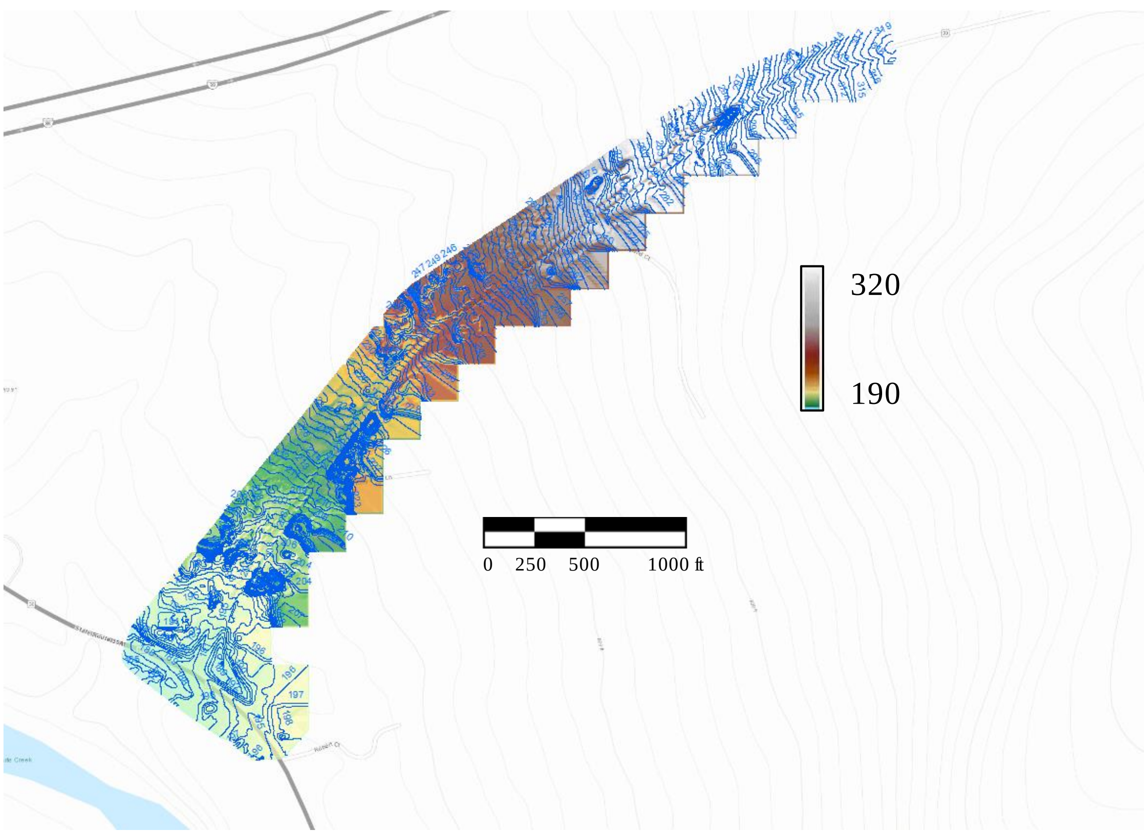


**Figure 6 – DTM overlaid on topo chart, color gradient and contours depict height above sea level, in meters.**

The terrain model resolution was reduced to 20 cm per pixel to minimize noise in the data and input to the ArcGIS Slope tool to calculate gradient in percent "run over rise". Additionally, the contours were converted to feet above sea level. Figure 7 depicts the resultant calculations with steeper grades in red transitioning to flatter areas in green. The graphic is split in two to aid visualization.

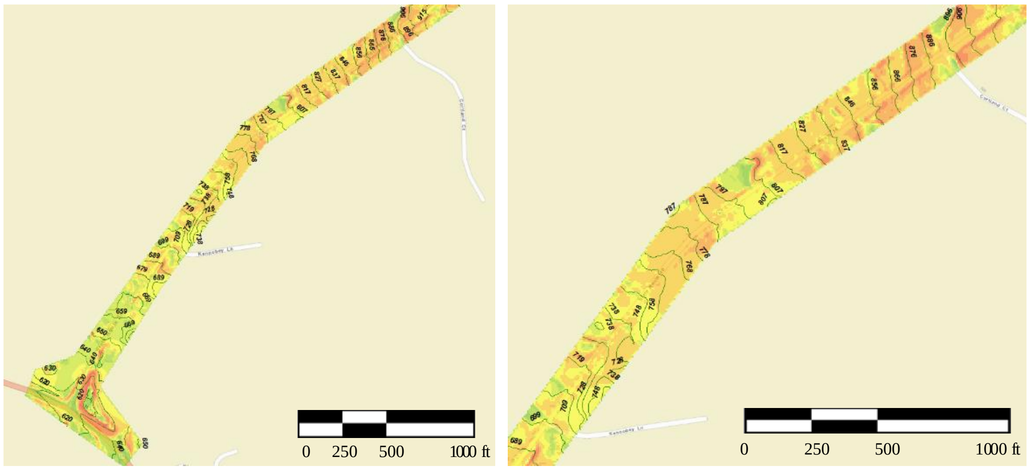


**Figure 7 – DTM converted to gradient in percent, contours in feet.**

In order to further reduce noise, the DTM was trimmed to eliminate artifacts along the edges of the road from items such as drainage ditches and landscaping. Figures 8 and 9 depict the grade in percent along the road in two sections to aid visualization.

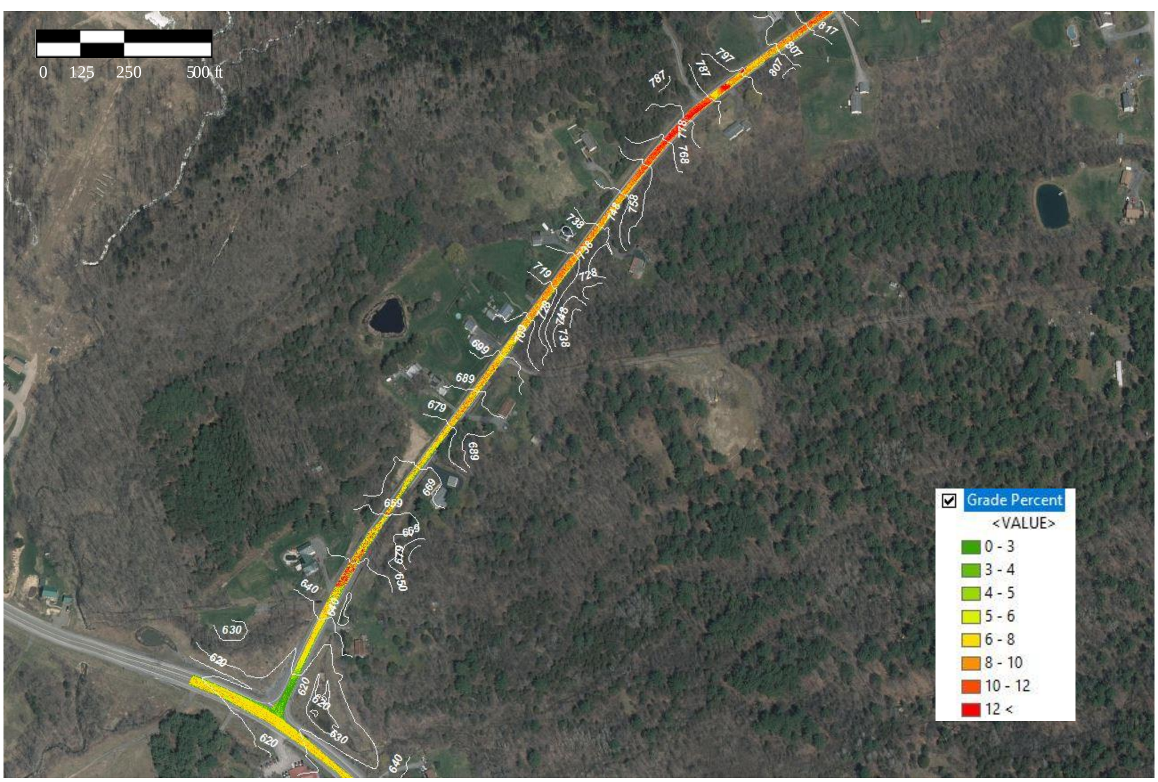


**Figure 8 – Snapshot of gradient map, lower portion of hill. Contours in feet above sea level.**


**Figure 9 – Snapshot of gradient map, upper portion of hill. Contours in feet above sea level.**

Figure 10 is a screen grab of a video “fly through” of the 3D Point Cloud.

**Figure 10 – Still excerpt from “fly through” of point cloud.**

## E. <u>ATTACHMENTS</u>

1. Google Earth kmz file
2. Orthomosaic geo-tiff (WGS84/UTM)
3. Orthomosaic geo-tiff (NY State Plane 3101)
4. Point cloud in xyz format
5. Digital terrain model
6. ArcGIS mxd map
7. Video clip
8. Video of point cloud fly-through