NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, DC 20594

May 17, 2019

Onboard Image, Audio, and Data Recorder

Specialist's Factual Report
By Sean Payne

1. EVENT

Location:	Mullen, Nebraska
Date:	August 3, 2018
Aircraft:	Airbus EC 130 T2
Registration:	N130TG
Operator:	Private
NTSB Number:	CEN18LA314

2. SUMMARY

On August 3, 2018, about 1545 mountain daylight time, an Airbus EC 130 T2 helicopter, N130TG, lost control while maneuvering near the Dismal River Golf Club, southwest of Mullen, Nebraska. The private pilot was not injured and the passenger sustained serious injuries. The helicopter sustained substantial damage. The personal flight was conducted under the provisions of 14 *Code of Federal Regulations* Part 91. Visual meteorological conditions prevailed and no Federal Aviation Administration (FAA) flight plan had been filed for the flight.

3. GROUP

A group was convened on February 21, 2019, at the Vehicle Recorder Laboratory at NTSB headquarters in Washington, D.C. The group consisted of the following members:

Chairman:	Sean Payne Mechanical Engineer/Investigator National Transportation Safety Board (NTSB)
Member:	Chihoon Shin Helicopter Engineer/Investigator NTSB
Member:	Van McKenney Aerospace Engineer/Investigator NTSB

4. DETAILS OF INVESTIGATION

On November 20, 2018, the National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following memory card from an image, audio and parametric data recording device:

Recorder Manufacturer/Model:	**Appareo Vision 1000**
Recorder Serial Number:	**Unknown (Memory Card Only)**

4.1. Appareo Vision 1000 Recorder Description

The Appareo Vision 1000 device is a small self-contained image, audio, and data recorder. The unit is typically mounted in the overhead of an aircraft's cockpit and records a cockpit image at a rate of four times per second. In addition to cockpit images, the device is also capable of recording two tracks of audio that are synchronized with the image data. The unit also contains a GPS receiver that receives GPS satellite-based aircraft time, position, altitude, and speed. In addition to the GPS position, the Appareo unit also has a self-contained real-time inertial measuring unit that provides 3-axis accelerations as well as aircraft pitch, roll and yaw data.

The two recorded audio tracks can be wired to record the following inputs: an external audio source such as the aircraft's intercom or radios and audio picked up by a microphone mounted internal to the Vision 1000 unit. In this installation one input was determined to be external aircraft audio that was wired to the helicopter's intercom and recorded pilot and crew communication. The other track only picked up very loud engine and/or transmission sounds from the helicopter and was determined to have been recorded by the Vision 1000's internal microphone.

The Appareo unit records the image, audio and parametric data on a removable SD[1] memory card that is inserted into the unit. Depending on card size, this removable memory retains approximately the last two hours of image and audio data and about the last 100 hours of parametric data. In addition to the removable memory the Vision 1000 is also equipped with a memory module that is mounted internal to the unit. This internal memory contains an exact duplicate of the data stored on the removable card.

The Appareo unit on this aircraft was connected to the aircraft's electrical bus. Any time the battery switch is turned on the Appareo unit will start to record audio, images and data. The Vision 1000 unit creates a new file for every electrical power application and can create multiple files for the same power cycle if the recording time exceeds a certain time limit.

[1] SD – Secure Digital – A type of nonvolatile memory card used extensively in portable devices.

4.2. Appareo Vision 1000 Damage

Upon arrival at the NTSB Vehicle Recorder Division, it was evident that the Vision 1000's SD memory card had not sustained any damage and was read normally, using a PC and the manufacturer's software.

4.3. Appareo Vision 1000 Data Recovery

The device's SD card was downloaded normally using a PC and the manufacturer's software.

Each time power is applied to the unit, a set of data files is created. The downloaded files from the repaired device contained a number of power cycles worth of data. By design, approximately the last two hours of files will contain image, audio and parametric data. Files outside of the last two hours of operation contain parametric data only.

The entire accident flight was recorded and included image, audio and parametric data. The flight is described in section 4.6.

4.4. Timing and Correlation

Timing information was recorded as UTC. The format given for this report is HH:MM:SS, where HH stands for the number of hours, MM, the number of minutes and SS, the number of seconds.

4.5. Appareo Vision 1000 Parametric Data Description

Parametric data containing information from the accident flight was extracted and provided in .CSV format as attachment 1.

Using parametric data from the accident flight provided in attachment 1, a KML[2] of the accident flight was created using the manufacturer's software. Figures 1 and 2 describes the accident flight, specifically in the area of the helicopter's loss of control.

Figure 1 is a north-up, top down view the helicopter's flight path in the region of the accident occurrence.

Figure 2 is the helicopter's flight path in the region of the accident occurrence oriented to show the helicopter's descent and turn profile just prior to the loss of control. The helicopter's position is shown just prior to the loss of control. Note that the flight path data is not ground truthed, and as such, the flight path appears well above the ground imagery. An EC130 model was not available in the manufacturer's software, an Airbus H125 (AS350) model was used in its place.

[2] KML – Keyhole Markup Language – a filetype for use with Google Earth.

4.6. Summary of Recording Contents

The Vision 1000 unit provided a field of view from over the pilot's shoulder and looking forward toward the instrument panel. The instrument panel was visible as well as the flight controls except for the collective stick. A view out of the forward windscreen and chin bubbles was also visible.

The audio track provided only ambient audio and no internal communications or external (VHF) communications were recorded.

Only video events at the time of takeoff and the time surrounding the accident were reviewed. Only video events at the time surrounding the accident were summarized. The summary below is a record of the image and audio recording recovered from the device.

A review of the video in the area of the accident showed a flagpole that indicated winds were generally out of south. The flag was flying mostly unfurled and the flag was fully visible. The helicopter entered this area making a right turn around a group of buildings. After one complete turn, the helicopter transitioned to making a left turn around the same group of buildings. This left turn was wider than the initial right turn. Nearing the time of the loss of control, this left turn began tightening in radius as the helicopter was descending. The helicopter continued descending in the decreasing radius left turn. During this time, derived groundspeed showed a significant decreasing trend. The airspeed indicator indicated about 30 knots at this time (21:29:40). As the helicopter's heading changed to the north during the decreasing radius left turn (the flagpole previously visible would indicate this as a tailwind), derived groundspeed continued to decrease, the airspeed indicator displayed about 0 knots (21:29:47) as the helicopter continued the turn to a northerly heading. As the helicopter became directly downwind, a loss of yaw control was immediately observed with the helicopter beginning a rapid yaw to the left. At this time, the derived groundspeed indicated about 17 knots, airspeed indicator remained on zero.

At the moment of loss of yaw control, the First Limit Indicator (FLI) read about 6.5 units, the pitch was nose down (about -18 degrees) and quickly became more nose down as the loss of yaw control continued. The pilot made some aft stick inputs around this time. There was a slight right pedal input observed, the right pedal was forward of the left pedal about an inch. As the loss of yaw control continued to develop, the pilot made a slight left pedal input. The helicopter continued yawing to the left and remained nose down (-18 degrees). The left pedal remained slightly forward of the right pedal until the time of ground impact. From the time of the loss of yaw control, the helicopter completed about 1.25 rotations to the left until ground impact.

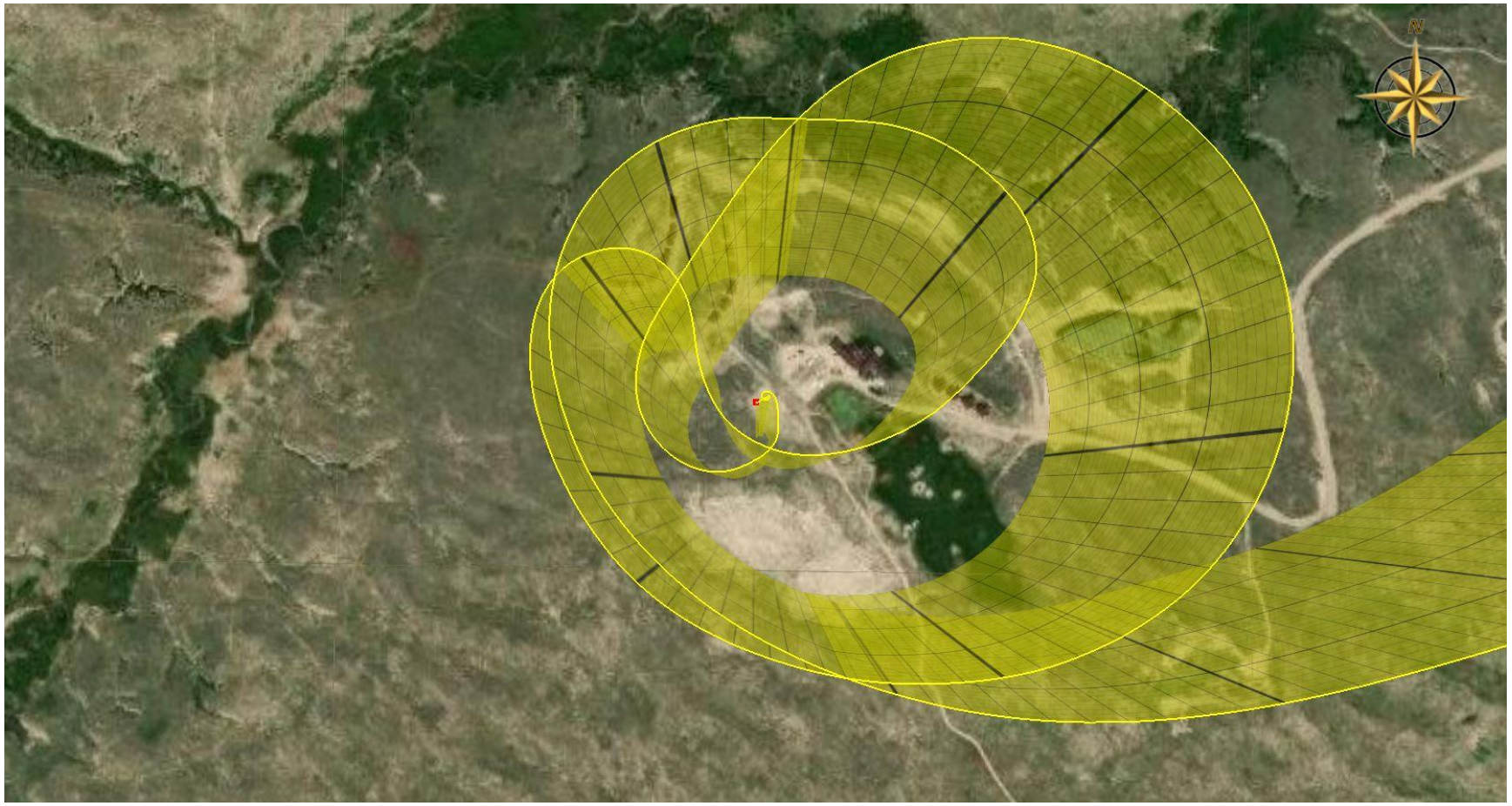

Figure 1. A north-up overview depiction of the helicopter's flight path in the region of the accident occurrence.

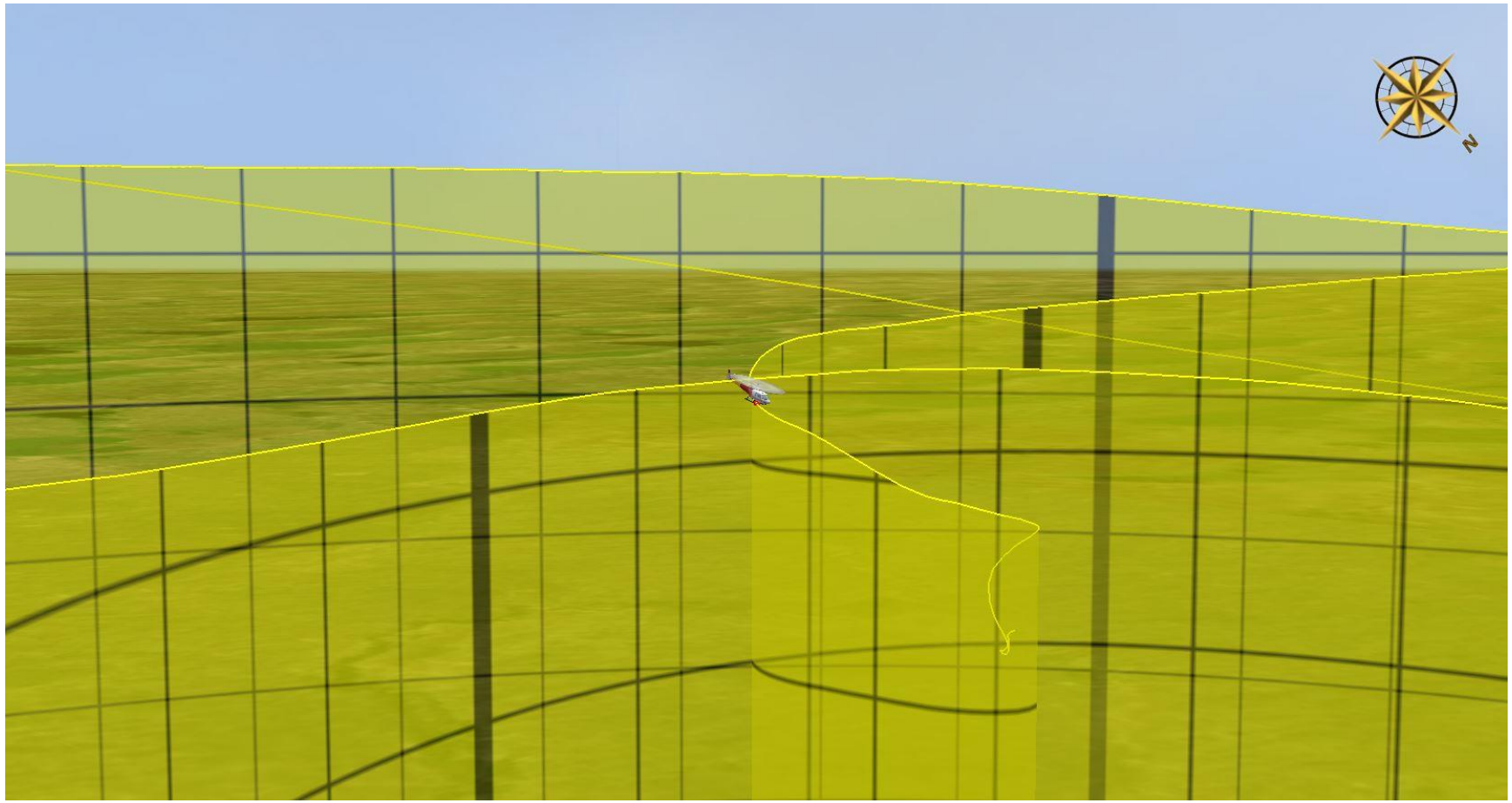

Figure 2. A figure of the helicopter's flight path arranged in a way to show the helicopter's descent profile and turn radius just prior to the loss of yaw control. Note that the data is not truthed to actual ground level and a different model helicopter was used for purposes of simulation.

APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters and table A-2 describes the unit abbreviations used in this report.

Table A-1. Verified and provided parameters.

Parameter Name	Parameter Description
Latitude	Latitude
Longitude	Longitude
Elevation	Altitude
GroundSpeed	Groundspeed
VerticalSpeed	Vertical Speed
Course	Ground Track
Heading	Heading
Pitch	Pitch
Roll	Roll
RollRate	Roll Rate
YawRate	Yaw Rate
NormalAccel	Normal Acceleration
LateralAccel	Lateral Acceleration
Slip	Slip/Skid Indication
TurnRate	Turn Rate
NormalField	Magnetic Field (Z Direction)
LongitudinalField	Magnetic Field (X Direction)
LateralField	Magnetic Field (Y Direction)
Fix	Fix Quality
HAcc	Horizontal Fix Accuracy
VAcc	Vertical Fix Accuracy

Table A-2. Unit abbreviations.

Units Abbreviation	Description
Degrees	degrees
Degrees/Sec	degrees per second
G's	g
Gauss	gauss
2D	two-dimensional fix
3D	three-dimensional fix
DGPS	differential GPS fix
Millimeters	millimeters