National Transportation Safety Board
Office of Research and Engineering
Washington, DC 20594

CEN23FA071

VIDEO FILE AND ONBOARD IMAGE, AUDIO, AND DATA RECORDER

Group Chairman's Factual Report

March 13, 2024

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A. ACCIDENT SUMMARY

Location:	Galliano, Louisiana
Date:	December 29, 2022
Time:	About 0833 central standard time (CST)
Airplane:	Bell 407, N595RL
Operator:	Rotorcraft Leasing Company, LLC

B. GROUP

A group was convened on March 13, 2023, at the National Transportation Safety Board's (NTSB) Vehicle Recorder Laboratory. The group consisted of the following members:

Chairman:	Deven Chen Electrical Engineer – Recorder Specialist NTSB
Member:	Fabian Salazar Air Safety Investigator NTSB
Member:	Edwin Miller Senior Aviation Accident Investigator Federal Aviation Administration
Member:	Jason Melancon Director of Operations Rotorcraft Leasing Company, LLC
Member:	Gary Howe Air Safety Investigator Bell Helicopter
Member:	David Riser Senior Air Safety Investigator Rolls-Royce Corporation

C. DETAILS OF THE INVESTIGATION

The NTSB Vehicle Recorder Division received the following onboard image, audio, and data recorder:

Device Manufacturer/Model:	Appareo Vision 1000
Serial Number:	VIS-FJM2

The NTSB Vehicle Recorder Division also recovered a video file from a personal electronic device (PED) belonging to a passenger onboard the Bell 407. The details of the recovery of this video file can be found in the *Personal Electronic Devices – Specialist's Factual Report* in this investigative docket. The content of this file is discussed in this report.

1.0 Passenger PED Video File Description

The passenger PED video file was in MOV format and was 31 seconds in length. Metadata in the video file indicated the video was recorded at about 8:32 a.m. CST on December 29, 2022, with 1920 x 1080 pixels at a frame rate of 30 frames per second (fps).

1.1 Passenger PED Video File Summary

The passenger was sitting in the forward-facing seat on the left side of the passenger compartment of the Bell 407. The camera was pointing outward from the window of the seat. Figure 1 is a screenshot showing the point of view of the camera. The times used in this summary are expressed as video elapsed time. The timing format is given in SS:FF, where SS stands for the number of elapsed seconds, and FF stands for the number of elapsed frames.

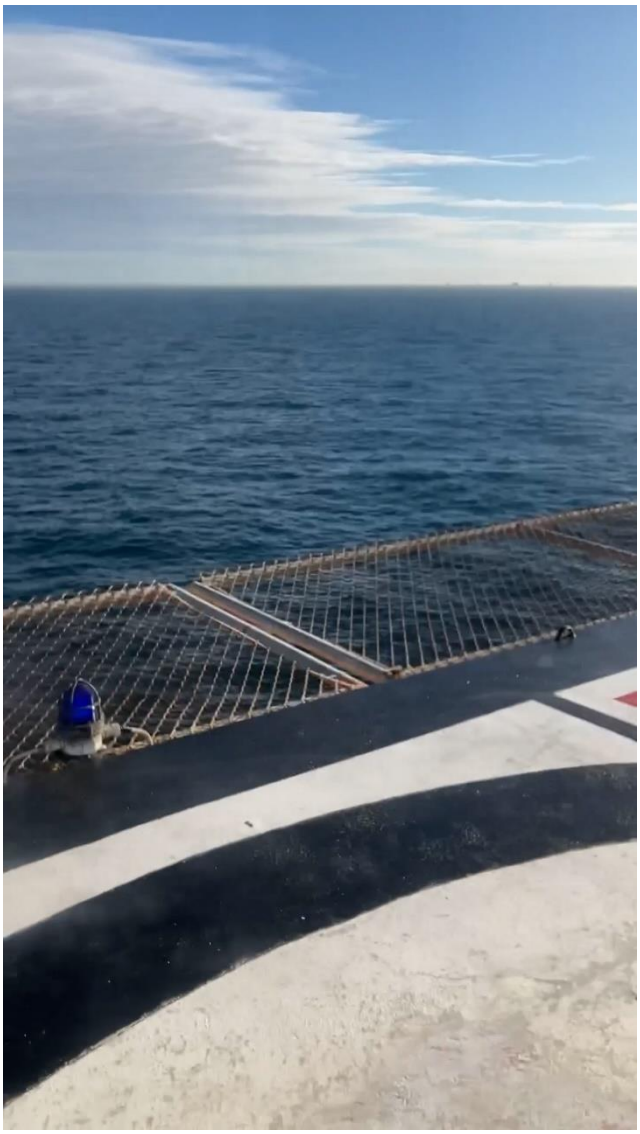

Figure 1. Screenshot showing the point of view of the PED camera.

From 00:00 – 27:21, the helicopter was stationary on the helipad. Rotor movement sound and engine sound were audible, and the sound was consistent with an increase of engine and rotor RPM (revolutions per minute) from "idle" to "fly."

At 27:22, the helicopter showed movement consistent with being light on the skids.

At 28:20, the helicopter started ascending. The helicopter did not appear to drift in either left or right or forward or back.

From 29:12 to 30:10, the helicopter started rolling to the right, and the recording showed the left skid started to rise. Figure 2 is a screenshot at 30:23 as the helicopter continued to roll to the right, the left skid and float is visible. An angle between the horizon and the bottom edge of the left seat window was apparent. The

time from when the helicopter began to ascend and began to roll was approximately 1.5 seconds.

Figure 2. Screenshot at 30:23, showing an angle between the horizon and the bottom edge of the left seat window while the helicopter was rolling to the right.

At 31:06, fragments of the helicopter's main rotor blades were visible in the air.

The video ended at 31:19.

2.0 Appareo Vision 1000 Description

The Appareo Vision 1000 device is a small self-contained image, audio, and data recorder. The unit is typically mounted in the overhead panel of the aircraft's cockpit and records an image at a rate of four frames per second with its internal camera. The device is also capable of recording audio that is synchronized with the image data. A GPS receiver is included that receives GPS satellite-based aircraft time, position, altitude, and speed. The Appareo unit also has a self-contained real-time inertial measuring unit that records 3-axis acceleration, and derived pitch, roll and yaw data.

Two independent audio tracks can be recorded, depending on installation and configuration. One track is from anything that can be picked up by the internal microphone of the device. The second track can be wired to an external audio source, such as the helicopter's intercom, as well as the communication between the pilot and crew through headphones.

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 internally to the unit.

In a typical installation, the Appareo unit is 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.

2.1 Appareo Vision 1000 Condition and Data Recovery

Data Recovery of the External SD Card

The Appareo Vision 1000 was contained in water upon arrival at the Vehicle Recorder Division. Figure 3 shows the condition of the device. A 32 GB SD card was found in the device. The SD card was cleaned and dried using laboratory procedures for water-damaged devices. After the recovery process, the SD card behaved normally when being read, and it contained both raw files and converted virtual drive files for numerous flights. The virtual drive files were playable within the manufacturer's playback software. The last flight recording was identified to be related to the accident, however, when played on the manufacturer's playback software, it did not show the accident. The last recovered image frame showed the helicopter idling on the helipad at 14:32:44 UTC on December 29, 2022.

The image file of the last flight recording was extracted into still images using laboratory forensic software. This process yielded approximately 9 additional seconds of image frames that were not shown on the manufacturer's playback software. These still images, combined with the audio file of the last flight recording, were reconstructed into a video file. This video file ended with the last image frame recorded at 14:32:53.25 UTC.

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

Figure 3. Front and back of the Appareo Vision 1000 as received.

Data Recovery of the Internal Memory Module

The internal circuitry of the Appareo Vision 1000 showed corrosion. The internal memory module was removed, cleaned, and dried using a laboratory procedure. The recovered memory module was then installed into a functional Appareo Vision 1000 surrogate. The surrogate powered up normally, and a full download following the manufacturer's procedure was successful. The downloaded data, 8 GB total, contained four flights, with the last flight being the accident fight. The image file of the accident flight ended shortly after the helicopter took off from the South Lafourche Leonard Miller Jr Airport (GAO), indicating the internal memory module of this Appareo Vision 1000 contained less data than the external SD card.

2.2 Appareo Vision 1000 Recording Description

The recovered accident flight recording consisted of parametric data and a video file with audio. The recording was 53 minutes and 11.5 seconds in duration, started at 13:39:41.75 and ended at 14:32:53.25 UTC, on December 29, 2022. The recording contained data of the flight from GAO to the helipad at the West Delta 106 offshore platform in the Gulf of Mexico. It also showed the helicopter idling on the helipad, the takeoff from the helipad, and the accident sequence.

The reconstructed video file reconstructed was MP4 format, with 1600 x 1200 pixels at a frame rate of 4 frames per second.

2.3 Time Correlation

The data were recorded in UTC and were kept in UTC for the rest of the report. Note that CST is behind UTC by six hours.

2.4 Appareo Vision 1000 Video Summary

The video started with the Bell 407 at the GAO airport, getting ready for takeoff at 13:39:41.75. Figure 4 shows the point of view of the camera during the flight. Due to the low resolution of the image and glare caused by the sunlight, the readings on the instruments on the instrument panel were unclear at times. When digital numbers on the instruments were unable to be determined by the group, they were represented with "X" in this report. For example, if the second digit of the three-digit number on the measured gas temperature (MGT) instrument is undetermined, the number would be noted as 3X1.

Figure 4. An image frame showing the point of view of the Appareo Vision 1000 camera.

From the start of the video to the helicopter's landing on the helipad of the oil platform, there were no abnormalities noticed. The group noted that the pilot did not perform a high reconnaissance prior to landing on the helipad of the oil platform. The

helicopter landed uneventfully at 14:25:57.75. Prior to the landing at 14:25:02.75, the helipad of the oil platform became visible for the first time on the pilot's side prior to the landing. The wave action of the water appeared to be at a low state.

At 14:26:02.75, the dual-tachometer and engine rotor dial indicator started reducing, and the low RPM caution light illuminated. The group determined the heading of the helicopter was 145 degrees from the directional gyro (DG); however, the DG heading indication does not align with the heading in the recorded parametric data (approximately 170 degrees). Further review showed that the DG heading indication mostly aligned with the heading in the recorded parametric data during enroute, and the difference between the two headings only started to increase as the helicopter approached the helipad. Shortly after, the passengers got off the helicopter, while the pilot remained inside the cockpit with the helicopter idling.

At 14:29:47.75, the outer border of the helipad was visible in the upper right corner near the south light based on Magnetic North. Figure 5 shows a diagram of the helipad. The direction of the Magnetic North and the south light are annotated on the diagram.

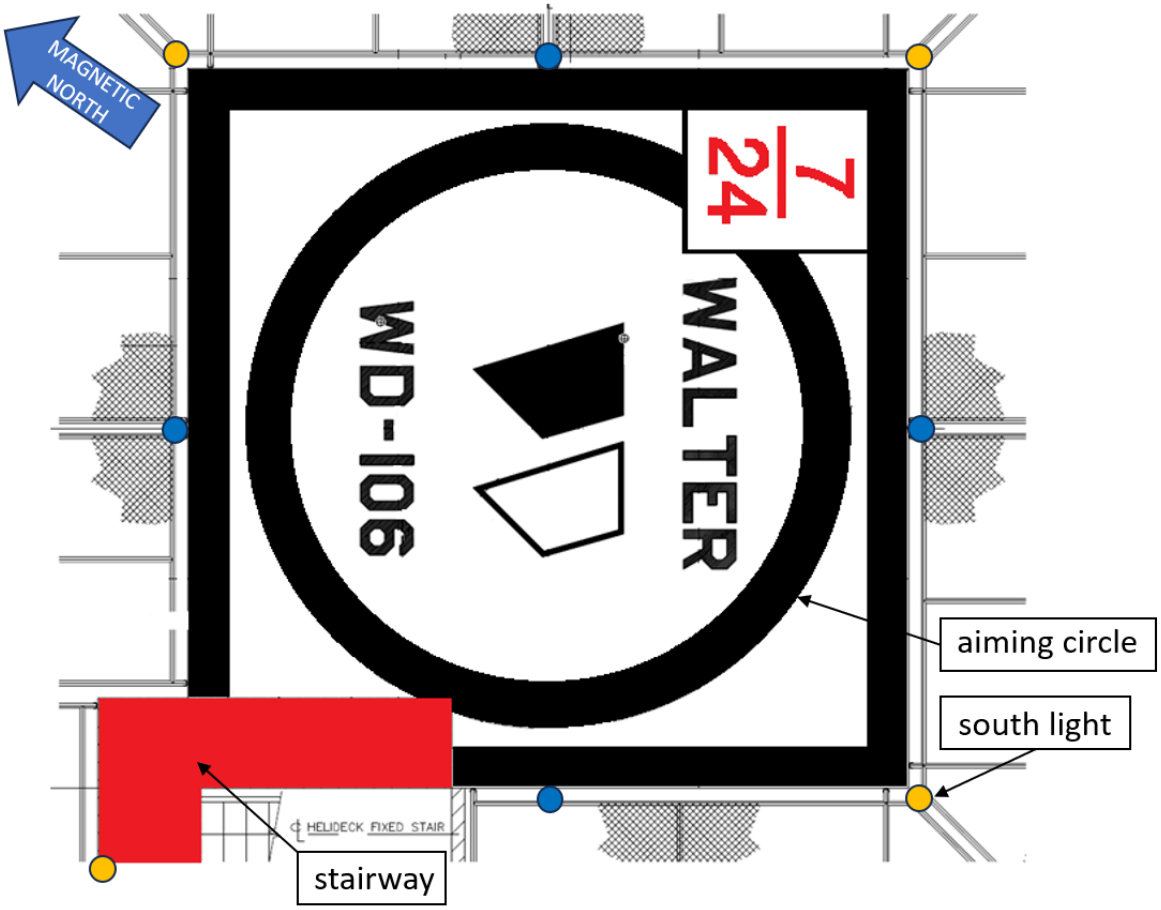

Figure 5. Diagram of the helipad with the south light, aiming circle, and Magnetic North annotated.

Around 14:31:06.75, some passengers arrived the helipad and started boarding the helicopter. A passenger sat down in the left front seat. There were no abnormalities noticed from the time when the passengers got off the helicopter to this time when passengers boarded the helicopter.

At 14:31:31.75, the right foot of the left front seat passenger was resting on the avionics shelf.

At 14:31:32.75, a part of the aiming circle was visible in the pilot's chin bubble. The tie-down was visible just past the pilot's shoulder harness. Figure 6 is the image frame at this time. Figure 7 and Figure 8 are additional image frames around the same time prior to the takeoff having a part of the aiming circle and the south light visible.

Figure 6. Image frame at 14:31:32.75. Parts of the image were redacted.

Figure 7. Image frame with a part of the aiming circle visible. Parts of the image were redacted.

Figure 8. Image frame with the south light visible. Parts of the image were redacted.

At 14:32.17.75, the pilot started advancing the throttle. The MGT indicated 525.

At 14:32:36.75, the rotor RPM light extinguished at about 96 percent NR (rotational speed).

At 14:32:37.75, the dual-tachometer was at 100 percent. All engine instruments were in the normal operating ranges. The transmission instruments were in the normal operating ranges. All flight instruments were in normal operating ranges. The altimeter reading was around 60 feet.

At 14:32:45.75, the motion of the helicopter suggested it was getting light on its skids. The MGT reading was 52X. The torque instrument indicated between 20 and 30 percent.

At 14:32:50.75, the south light (based on Magnetic North) disappeared from view, and the nose of the helicopter was moving to the right. The torque instrument reading was between 50 and 60 percent. The MGT reading was 5X5. The heading remained the same at 145 degrees. The attitude indicator started to show a right

bank (one bar width of the indicator). The turn rate indicator started to show a right bank (one half bar width).

At 14:32:51.50, the artificial horizon indicated 10 degrees right bank. The MGT reading was at 6XX. The torque was at approximately 65 percent. The DG was still at a heading of 145 degrees. The VSI (vertical speed indicator) indicated around 200 FPM (feet per minute) and indicated a climb trend. The altimeter reading was at around 60 feet.

At 14:32:51.75, the artificial horizon indicated 10 degrees right bank. The MGT reading was at 6XX. The torque was approximately 65 percent. The DG was still at 145 degrees. The VSI indicated around 200 FPM and indicated a climb trend. The altimeter reading was at around 65 feet. The turn rate indicator was showing a left bank (one bar width of the indicator).

At 14:32:52.00, The pilot's body started moving to the left (opposite of the direction of the helicopter's bank). The artificial horizon increased to15 degrees right bank. The torque was at approximately 70 percent. The MGT reading was at 6XX.

At 14:32:52.25, the artificial horizon indicated approximately 22 degrees right bank. The torque was between 70 and 75 percent. The MGT reading was at 65X.

At 14:32:52.5, the pilot's body covered all of the instrument panel as the pilot continued moving to the left. The helicopter was banked right.

At 14:32:52.75, the south corner of the helipad's black border was visible at the upper right corner of the image as the helicopter continued rolling to the right. The lower instrument panel was also visible and appeared to be an increased right bank angle. Figure 9 shows the image frame at this time.

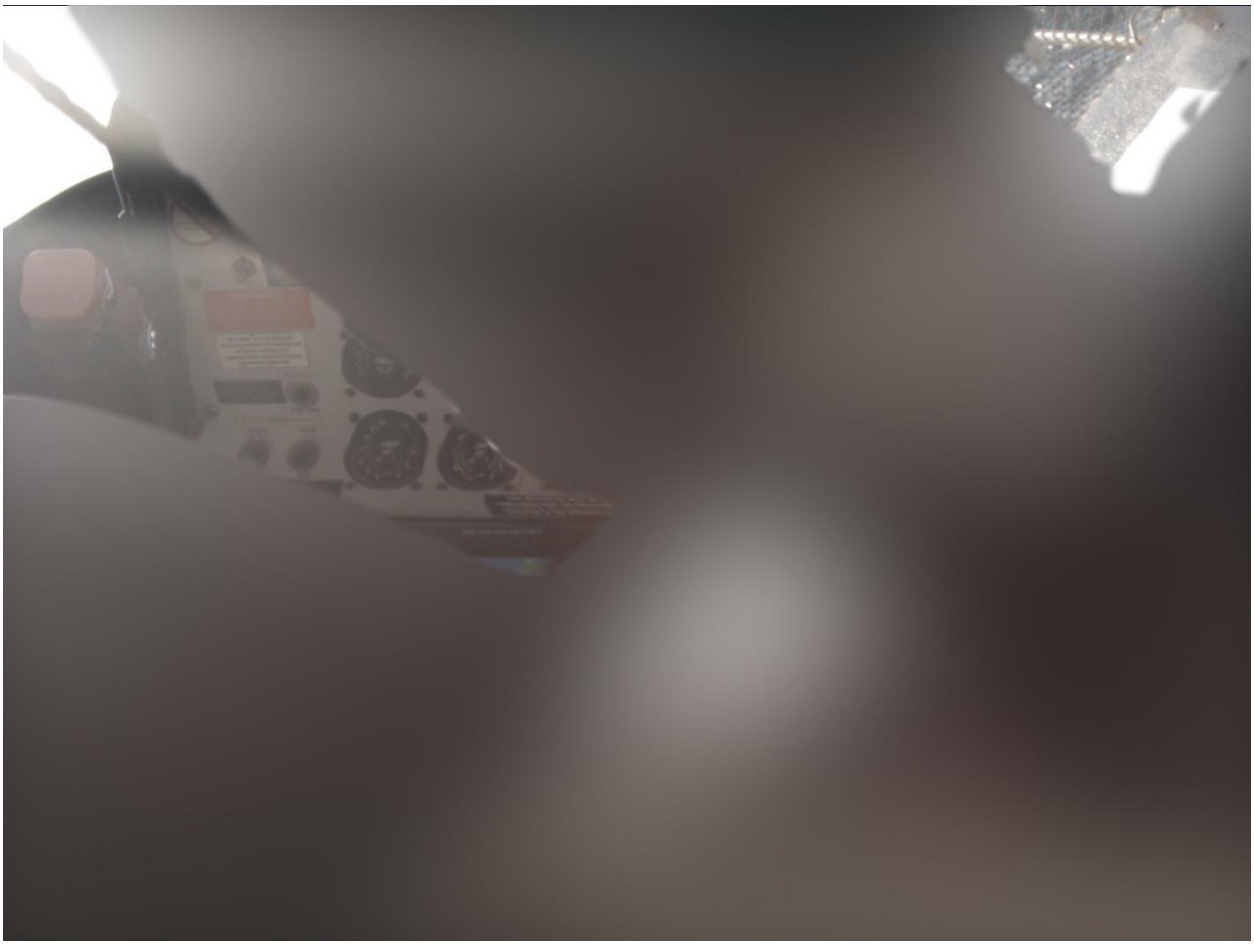

Figure 9. Image frame at 14:32:52.75. Parts of the image were redacted.

The last image frame was recorded at 14:32:53.25. The pilot's body had continued moving to the left. An amber caution light illuminated on the instrument panel. The amber caution light was consistent with the appearance and position of the "FADEC Degraded" caution light.

No other imagery was recovered from the device.

2.5 Appareo Vision 1000 Parametric Data

The parametric data were recorded at a sampling rate of 4 Hz. A review of the parametric data showed an offset in the recorded pitch and roll values for the dataset. This is likely a result of the Appareo Vision 1000 being installed at an angle and the proper offset not being entered when the unit was configured. The offset was corrected based on pitch and roll readings when the helicopter was stationary on the ground. Table 1 lists the recorded parameters verified and provided in this report.

Table 1. Appareo Vision 1000 data parameters provided.

Parameter Name (unit)	Parameter Description
Elevation (Feet)	Geometric altitude above Mean Sea Level (feet)
GroundSpeed (Knots)	Groundspeed between current and previous data point (knots)
Heading (Degrees)	Aircraft heading (degrees)
Latitude (Degrees)	Geometric latitude (degrees)
LateralAccel (G's)	Lateral acceleration (G's)
Longitude (Degrees)	Geometric longitude (degrees)
LongitudinalAccel (G's)	Longitudinal acceleration (G's)
NormalAccel (G's)	Normal acceleration (G's)
Pitch (Degrees)	Corrected pitch angle (degrees)
Roll (Degrees)	Corrected roll angle (degrees)
VerticalSpeed (Ft/Min)	Vertical speed (feet per minute)
YawRate (Degrees/Sec)	Yaw rate (degrees per second)

2.5.1 Plots and Corresponding Tabular Data

Figures 10 to 13 contain parametric data recorded during the accident flight on December 29, 2022.

Figure 10 to Figure 12 are parameter plots during the accident flight. These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

Figure 13 is a Google Earth overlay of the accident flight track. The reported wreckage location is shown with a red pin. Note that the weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

The corresponding tabular data used to create figures 10 to 13 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

Submitted by:

Deven Chen
Electrical Engineer – Recorder Specialist

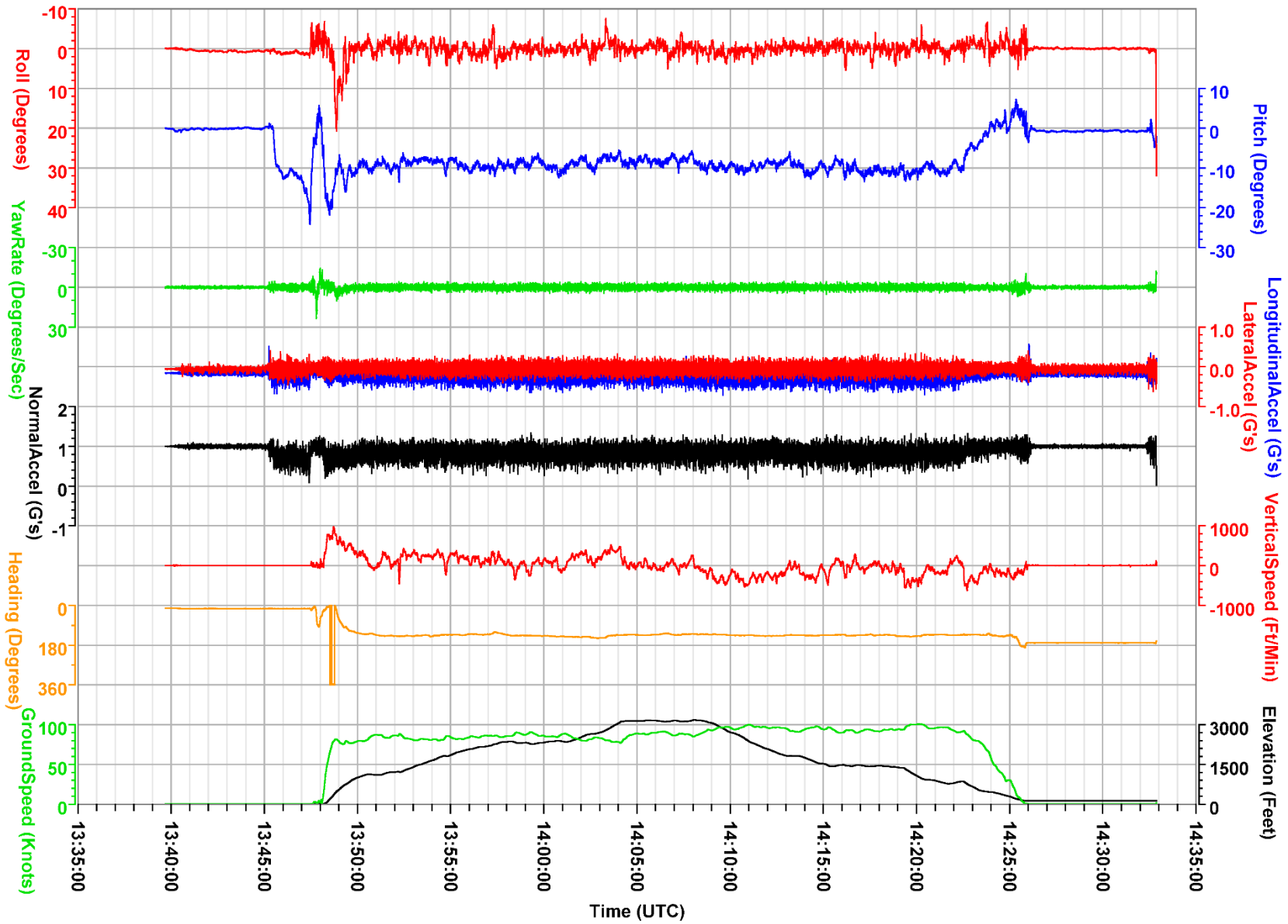

Figure 10. Plot of parametric data for the entire accident recording.

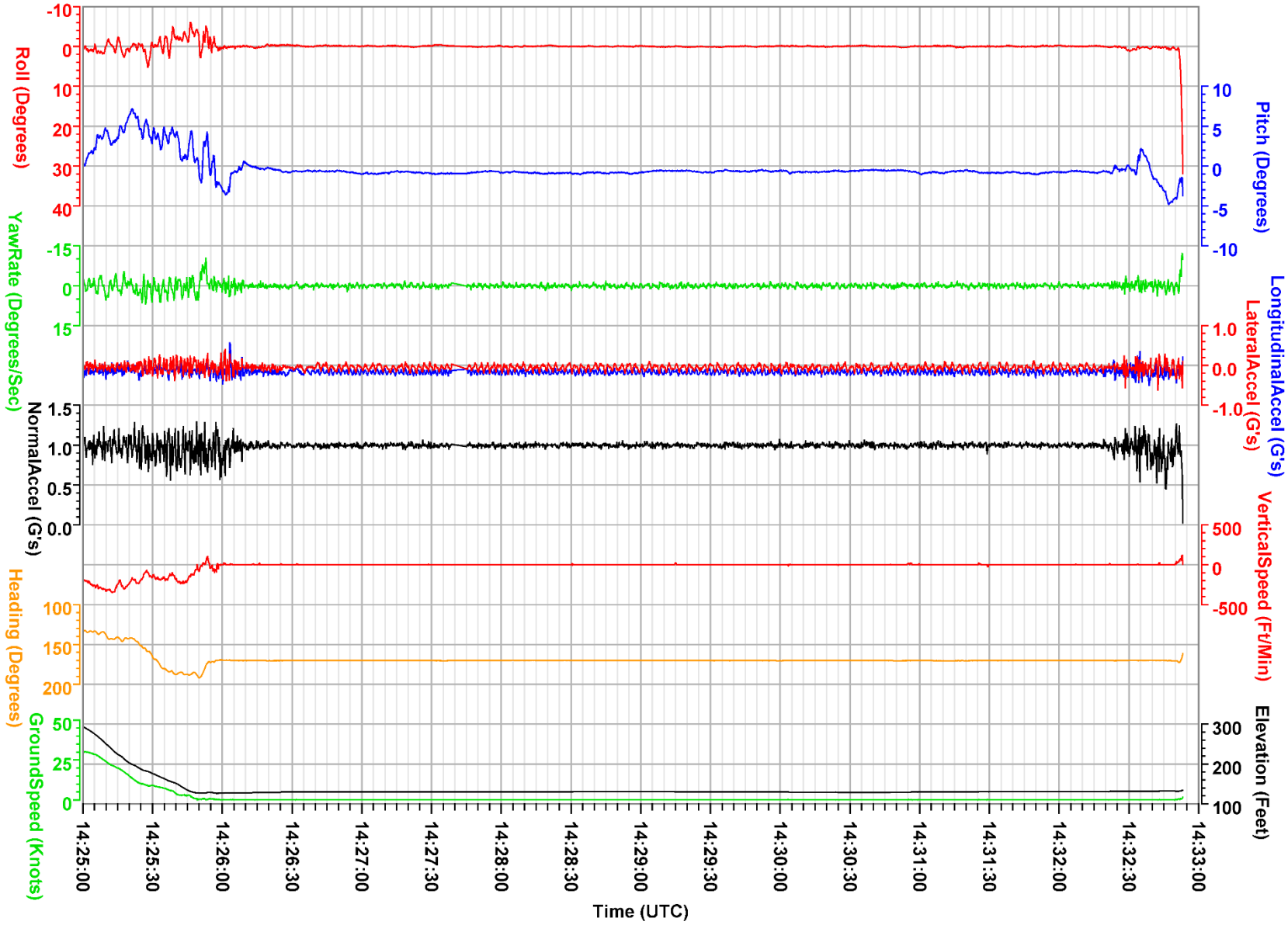

Figure 11. Plot of parametric data for the session between 14:25:00 and the last recorded point.

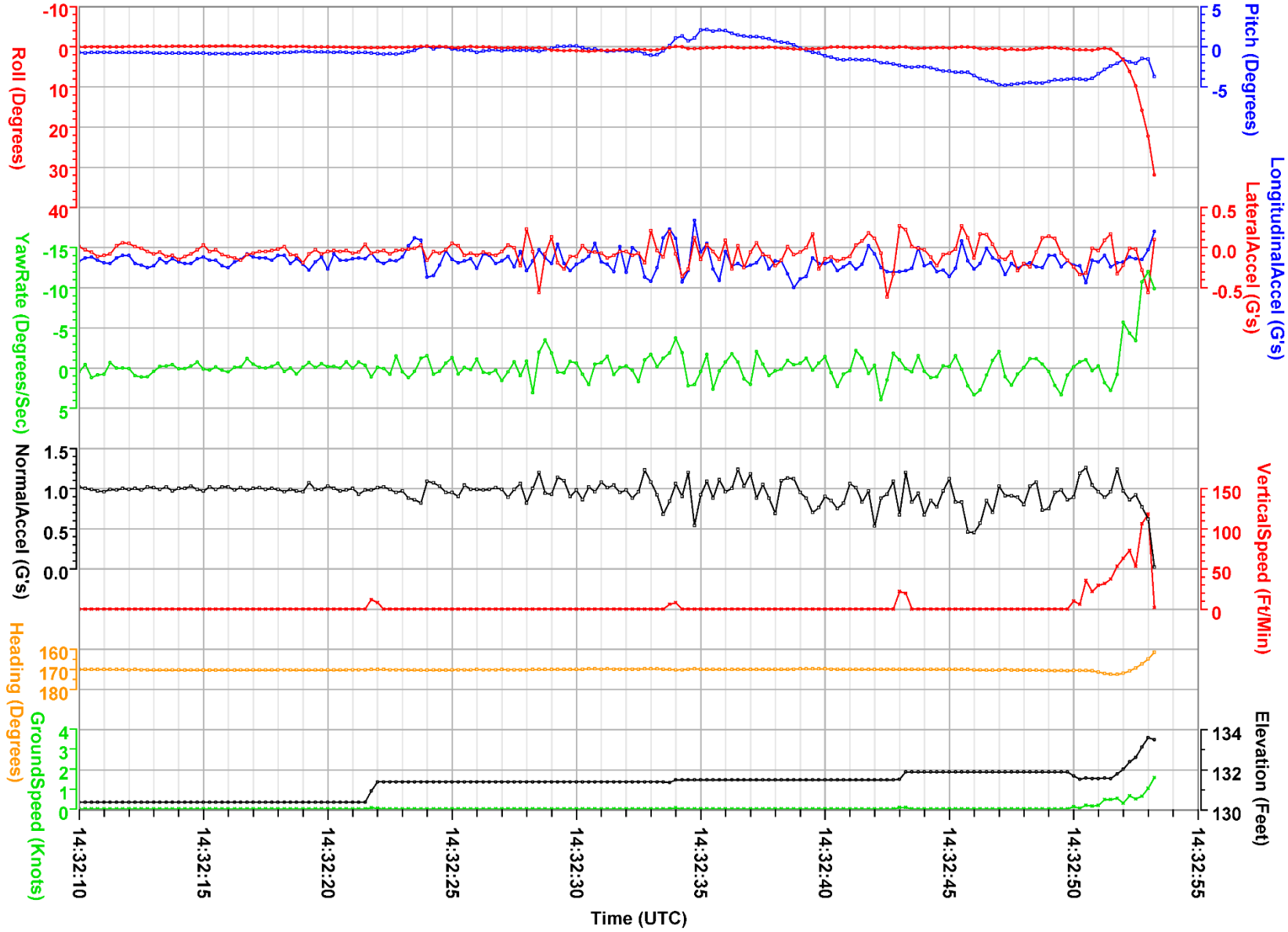

Figure 12. Plot of parametric data for the session between 14:32:10 and the last recorded point.

Figure 13. Google Earth overlay of the entire accident flight track.