

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

May 1, 2019

Flight Data Monitoring (FDM) Device - Data

Group Chairman's Factual Report

By Sean Payne

1. EVENT SUMMARY

Location: Chicago, IL
Date: July 07, 2018
Helicopter: Eurocopter Deutschland GMBH EC135 P1
Registration: N312SA
Operator: Bennett Aviation
NTSB Number: CEN18FA259

On July 7, 2018, about 2124 central daylight time (CDT), an Eurocopter Deutschland GMBH EC135 P1 helicopter, impacted terrain during an autorotation following a dual engine failure while maneuvering near Chicago, Illinois. The pilot and paramedic sustained minor injuries, the flight nurse sustained serious injuries, and the patient was not injured during the accident. The helicopter sustained substantial damage to the fuselage, tailboom, and main rotor blades. The helicopter was owned by Bennett Aviation, LLC, Elmhurst, Illinois, and operated by Pentastar Aviation Charter under the provisions of 14 *Code of Federal Regulations* Part 135 as an air ambulance flight. Night visual meteorological conditions prevailed at the time of the accident, and the flight was operated under a visual flight rules flight plan. The flight departed St. Mary Medical Center, Hobart, Indiana, at 2110, and was destined for Advocate Christ Medical Center, Oak Lawn, Illinois.

2. GROUP

A flight data group was convened on August 21st and 22nd, 2018 at the Vehicle Recorder Division Laboratory at the NTSB headquarters in Washington, DC. The group members who participated are listed below:

Chairman: Sean Payne
Mechanical Engineer
National Transportation Safety Board (NTSB)

Member: Aaron Sauer
Investigator-In-Charge (IIC)
NTSB

Member: Eric West
Senior Air Safety Investigator
Federal Aviation Administration (FAA)

Member: Merryn Spielman
Crash Investigator
Pratt and Whitney Canada

Member: Scott Traylor
Pilot
Pentastar Aviation

Member: Seth Buttner
Senior Accident Investigator
Airbus Helicopters

Member: Christian Bernhardt
Accident Investigator
Airbus Helicopters Deutschland

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following global positioning system (GPS) device:

Device Manufacturer/Model:	Outerlink IRIS Data Comm Processor
Serial Number:	00181

3.1. Flight Data Monitoring (FDM) Device Carriage Requirements

Per federal regulation 14 CFR 135.607, helicopters in air ambulance operations must be equipped with an approved flight data monitoring system capable of recording flight performance data. The system must receive electrical power from the bus that provides the maximum reliability for operation without jeopardizing service to essential or emergency loads and be operated from the application of electrical power before takeoff until the removal of electrical power after termination of flight. This rule went into effect on April 23, 2018. The rule does not include the helicopter air ambulance operators perform periodic reviews of the flight data to ensure the data is valid, or use the flight data in any kind of flight operations quality assurance (FOQA) program. Additionally, there is no requirement that the FDM devices be certified to any crashworthiness standard.

3.2. Outerlink IRIS Description

The Outerlink IRIS is a lightweight flight data monitoring, recording and satellite communications device. The system consists of two main components, a control head that is installed in the helicopter's instrument panel as well as a second processing device which is installed in the helicopter's avionics bay. The system provides instantaneous two way communication between the helicopter's flight crew and any equipped ground operator (IP or telephone) via a global satellite network.

In addition to communications features, the device provides flight data monitoring features and the ability to record these functions. The unit contains an internal Attitude Heading Reference System (AHRS) as well as components that facilitate the input of ARINC avionic data streams. A typical configuration will record native AHRS data as well as a variety of ARINC labeled messages that could potentially record engine information.

The system can also record voice and video data. In a typical configuration, the helicopter's intercom system (ICS) is configured to interface with the IRIS device. The pilot's headset hot mic and ear cups are recorded to the IRIS through the ICS system. Additionally, a lipstick style video camera interfaces with the system and is set to record a view over the pilot's shoulder of the helicopter's cockpit, including the pilot's control stick inputs as well as portions of the instrument panel and windscreen.

Data is recorded in three places on the IRIS system. The pedestal mounted control head contains a removable SD card which records only flight data. Inside the control head and the processor unit, a solid-state hard drive (SSD) is configured to record flight data, audio and video data. The SSD can be accessed through a hardwire ethernet connection on the back of each device or the unit can be disassembled and the SSD can be read independently. The IRIS system runs on a version of the Linux operating system.

3.3. Data Recovery

Data was recovered by removing the non-volatile memory component of the unit and reading it via a forensic write blocker attached to a PC. Data logs as well as video information were extracted from the filesystem. Data logs were converted to .CSV¹ which were input to NTSB plotting software. Video data was played back using commercial off the shelf software.

¹ .CSV – comma separated values.

3.4. Data Description

Data

The accident flight was recorded starting around 02:08:00 UTC. Valid data ceased being recorded around 02:24:18 UTC.

The dataset is limited to only parameters that could be validated in the context of this investigation. Other parameters recorded by the device were not plotted as their validity could not be verified.

The parameter for “True Course” was converted from a recorded parameter for magnetic heading. The raw data for magnetic heading was consistent with being recorded with an offset to valid magnetic heading. A discussion with the FDM device manufacturer suggested that the possibility exists that the FDM device was not properly calibrated when installed. Values for magnetic heading were compared with the helicopter’s groundtrack and were offset to create the parameter “True Course” which is plotted in this report. Some errors for this parameter may appear in the dataset, such as small time intervals when the data became negative in value. This small area of negative values was not corrected.

Recorded GPS position data was found to be in error. GPS position data used to construct figures 1 and 2 were provided by a third-party company which collects real-time helicopter position data. Attachment 2 is a .KML² file containing this data. The tracking data sampled the helicopter’s position one time every ten seconds.

Video

Video information associated with the accident flight was determined to be not useful to the investigation. The video imagery appeared blurred and out of focus. Figure 1 is a photo of the video camera associated with the accident helicopter. Focal length and focus are set via two external set screws. Upon arrival at the laboratory, these set screws could be moved without tools or excessive force.

On May 25, 2018, the manufacturer of the FDM device issued a service bulletin titled: N00-5300 Camera. The purpose of the service bulletin was listed as “to provide better retention of the focus ring allowing the camera to remain in focus.” The service bulletin provides instructions to modify the camera’s focus ring assembly by adding to additional holes for two additional set screws which are used to retain the focus ring from moving. As shown in figure 1, only one set screw is in place on the camera’s focus ring which indicates that the service bulletin was not applied to the camera system installed in the

² KML – Keyhole Markup Language.

accident helicopter. The service bulletin (N00-5300) is provided in this report as attachment 3.

In addition to the service bulletin, the manufacturer of the device is looking into incorporating a software change which dumps one still picture file onto the removable memory card associated with the FDM device. The still picture file would be recorded at a regular, but long, interval. This would theoretically allow operators to sample the focus quality of the image data without performing a full download of the device's internal memory.



Figure 1. The camera system associated with the accident helicopter.

Audio

Audio information from this FDM device is discussed in the report titled, Flight Data Monitoring (FDM) Device – Audio – Group Chairman's Factual Report, which can be found in the public docket for this investigation.

3.5. Parameters Provided

Table 1 describes data parameters provided by the FDM device.

Table 1: FDM Data Parameters

Parameter Name	Parameter Description
Time	Time (UTC) for recorded data point (HH:MM:SS)
Altitude	Recorded GPS altitude (feet)
Collective Angle	Collective angle (percent)
Ground Speed	Average derived groundspeed (knots)
NR 112%	Rotor speed greater than 112% (discrete)
Pitch	Pitch angle (degrees)
Roll	Roll angle (degrees)
Body Accel X	Acceleration in X-Axis (g)
Body Accel Y	Acceleration in Y-Axis (g)
Body Accel Z	Acceleration in Z-Axis (g)
XMSN Oil P 1	Transmission oil pressure – source 1 (discrete)
XMSN Oil P 1	Transmission oil pressure – source 2 (discrete)
Fire 1	Fire discrete – source 1 (discrete)
Fire 1	Fire discrete – source 1 (discrete)
True Course	True Course (degrees)

3.6. OVERLAYS AND TABULAR DATA

Figure 2 is a graphical overlay generated using Google Earth for the entire accident flight. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording. The plot is oriented north up.

Figure 3 is a graphical overlay generated using Google Earth for the final portion of the accident flight. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording. The plot is oriented looking toward the southwest.

Figure 4 is a plot covering the main parameters of interest between 02:08:00 to 02:25:00. This time interval highlights an area of data where values for torque diverged.

Figure 5 is a plot covering the main parameters of interest between 02:14:00 to 02:17:00. This time interval highlights an area of data where values for torque diverged as well as expanded detail into other parameters such as collective position, pitch and roll.

Figure 6 is a plot covering the main parameters of interest during the entire accident flight. The plotted time interval is from 02:19:00 to 02:25:00.

Tabular data used to generate figures 3 through 5 are included as Attachment 1. This attachment is provided in electronic comma-delimited (.CSV) format.

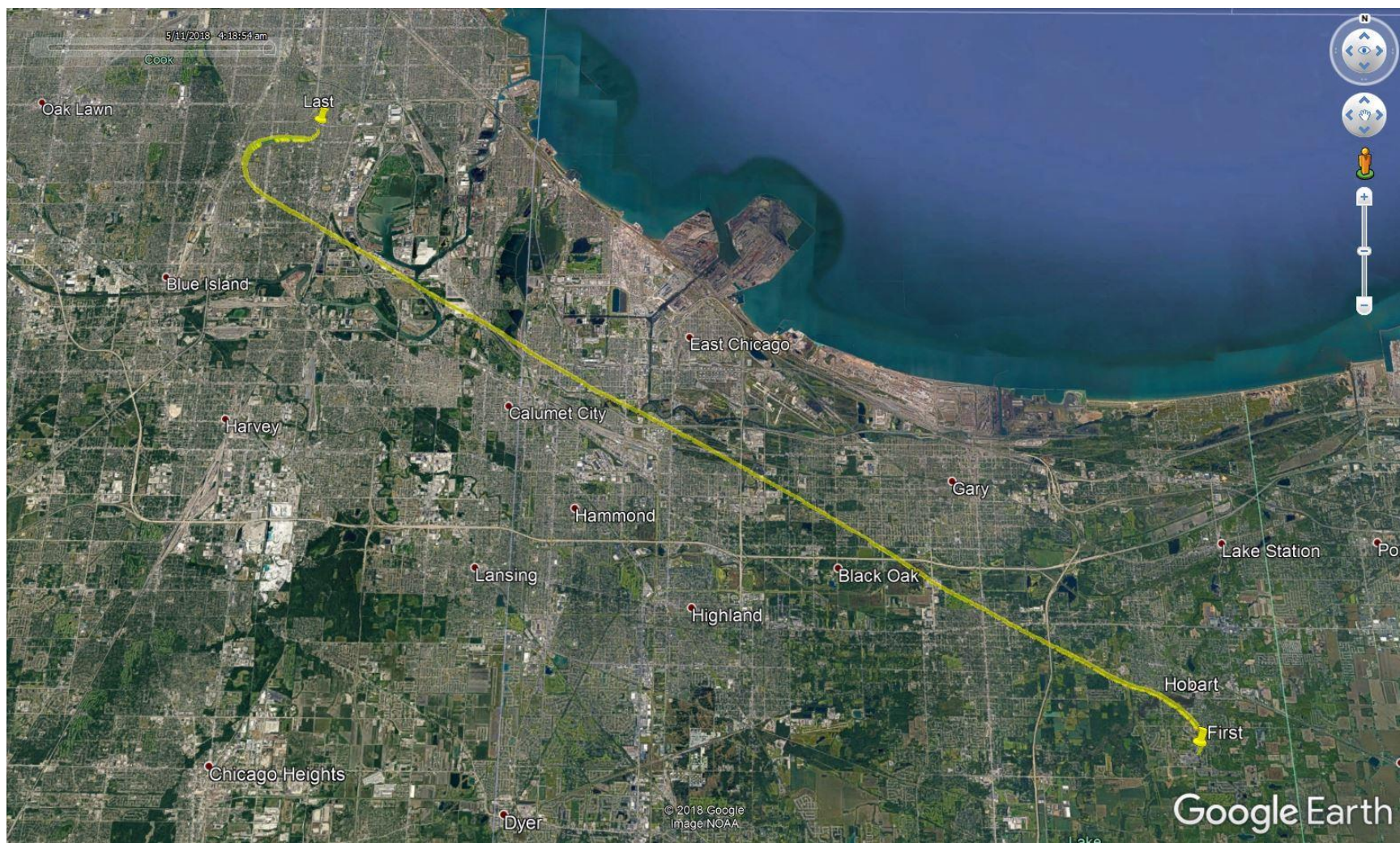


Figure 2. Google Earth overlay showing the entire accident flight.

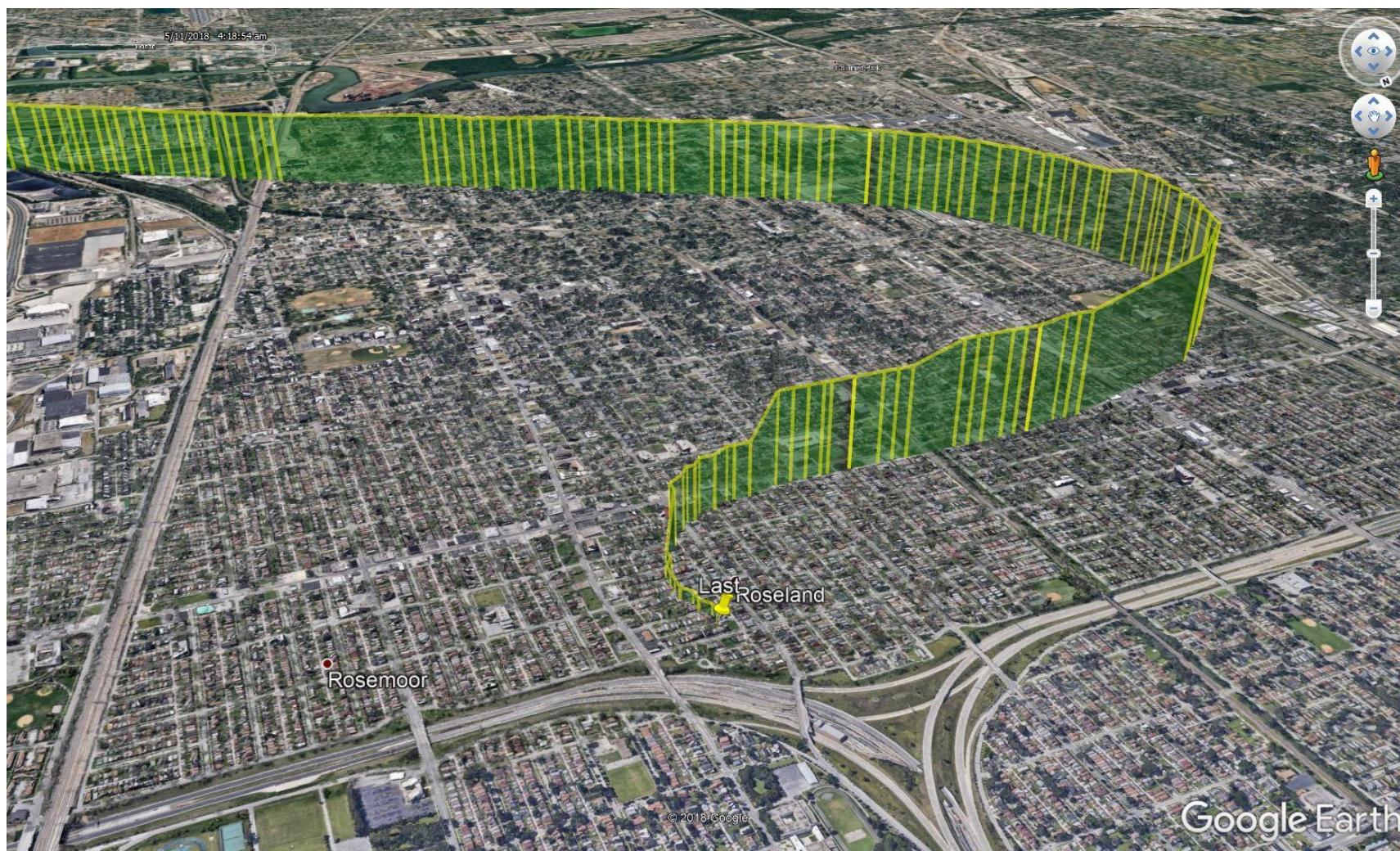


Figure 3. Google Earth overlay showing the final portion of the accident flight. Data for the overlay ends prematurely.

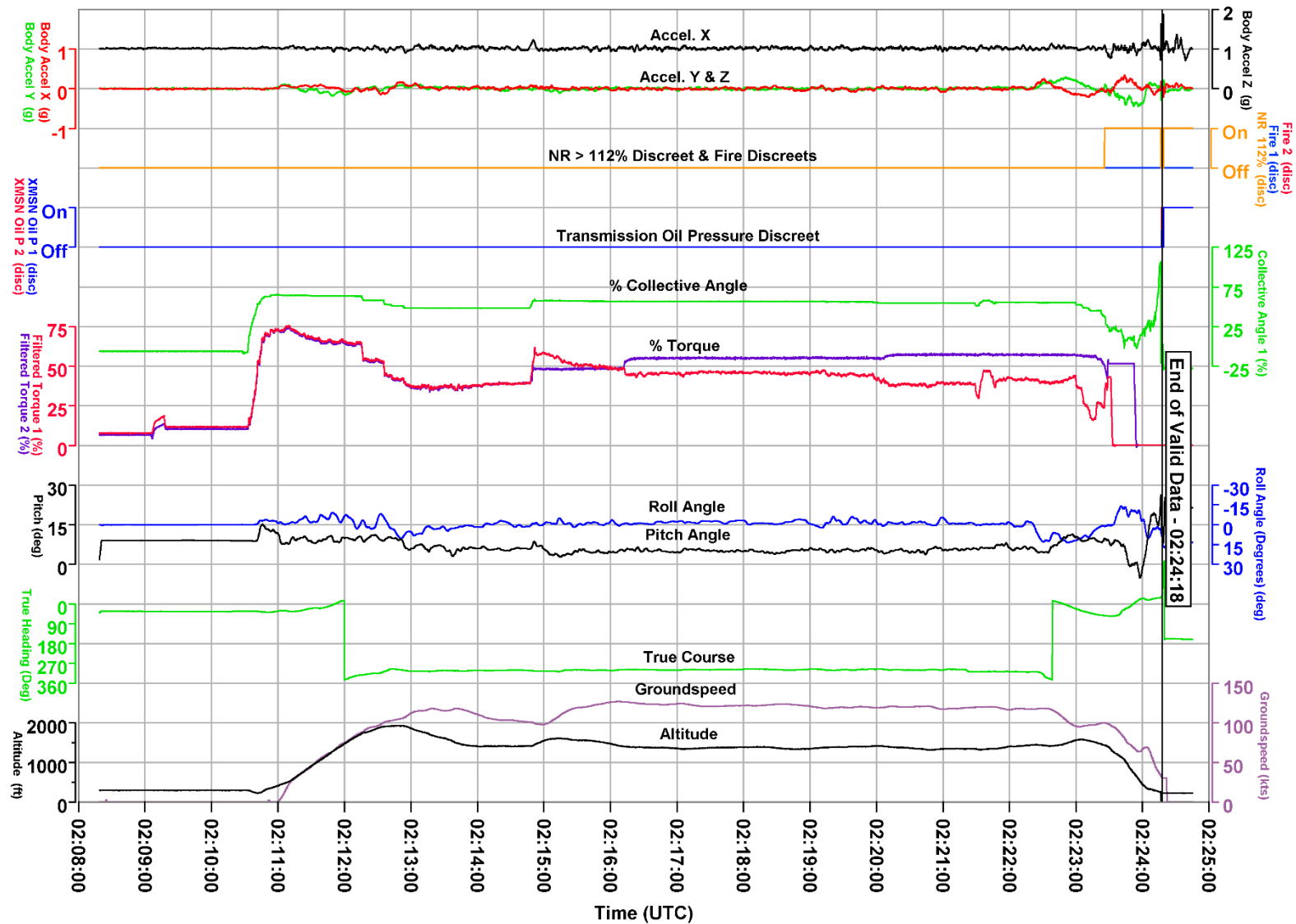


Figure 4. Plot of main parameters of interest for the entire accident flight.

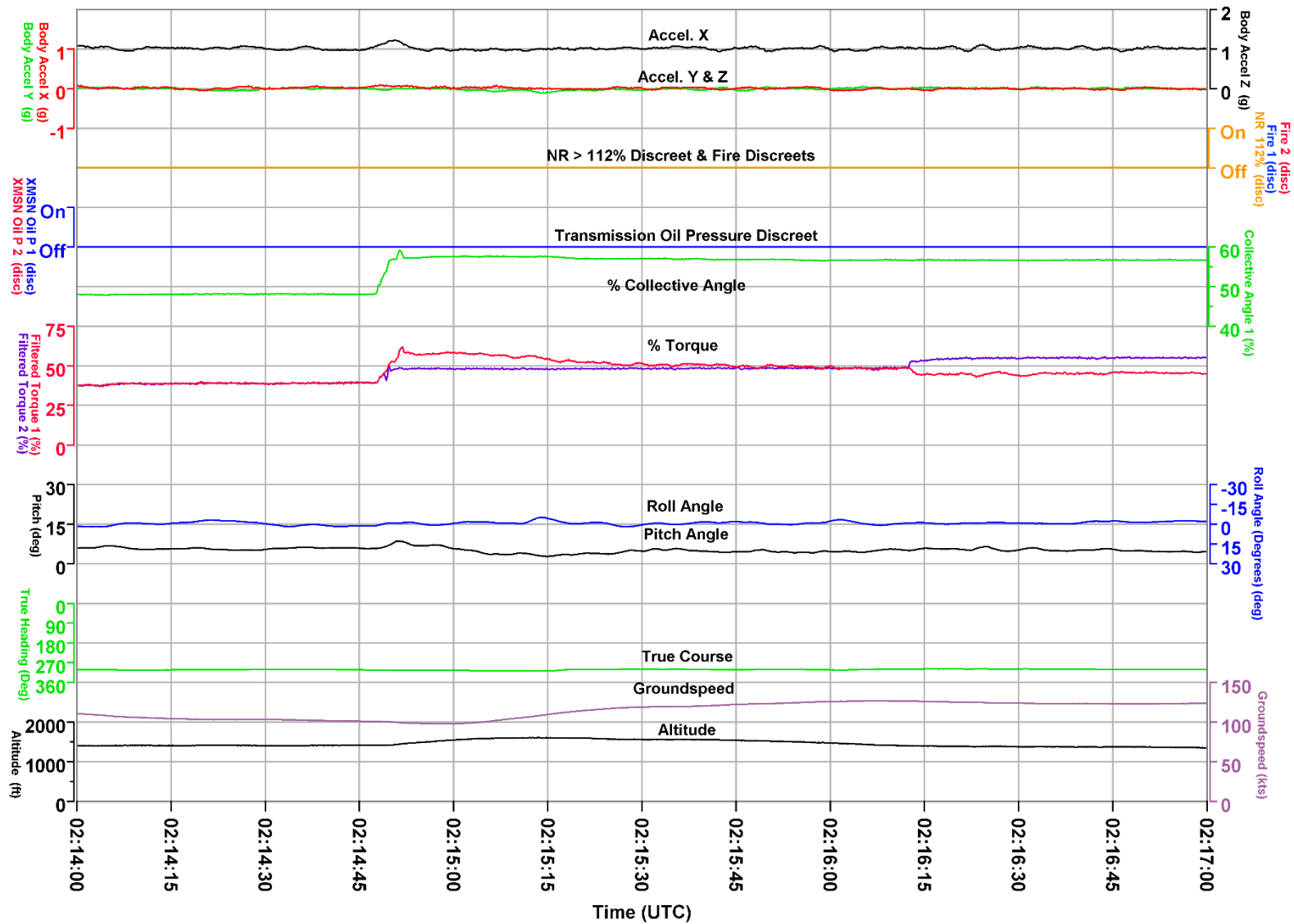


Figure 5. Plot of main parameters of interest for the accident flight between 02:14:00 and 02:17:00.

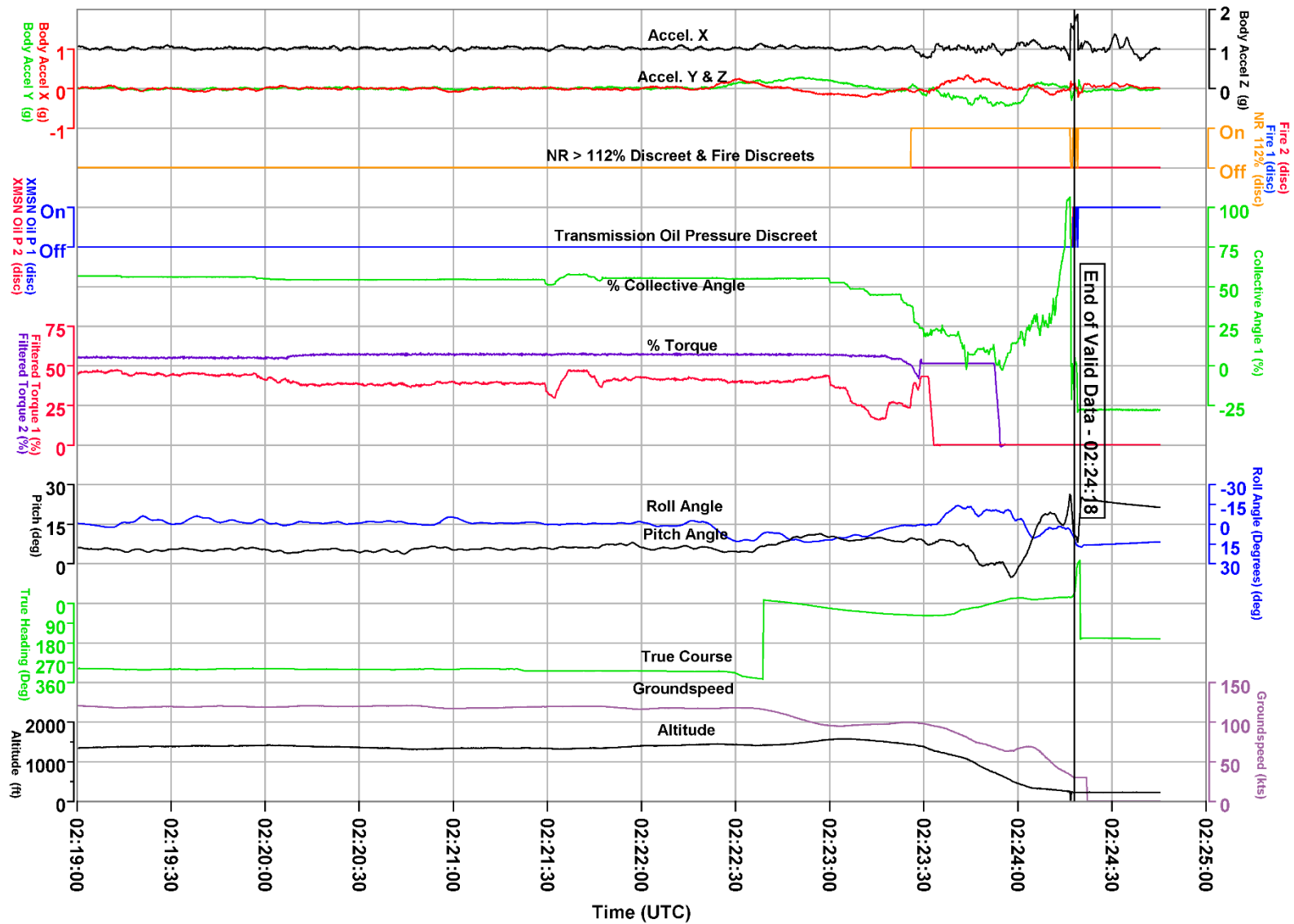


Figure 6. Plot of main parameters of interest for the accident flight between 02:19:00 and 02:25:00.