

National Transportation Safety Board
Office of Research and Engineering
Washington, D.C. 20594

Airplane Performance Study

Specialist Report Timothy Burtch

A. ACCIDENT

Location: Kapalua, Hawaii
Date: August 18, 2019
Time: 2038 GMT (1038 HST)
Airplane: Cessna 208B Caravan, N879MA
NTSB Number: ANC19LA046

B. GROUP

No vehicle performance group was formed.

C. SUMMARY

On August 18, 2019, about 1038 Hawaii-Aleutian standard time (HST), a turbine-powered Cessna 208B airplane, N879MA, sustained substantial damage after overrunning the end of runway 2 during landing at the Kapalua airport (HJH¹) in Lahaina, Hawaii. The airplane was being operated by Mokulele airlines as flight 504, a scheduled commuter flight under the provisions of 14 Code of Federal Regulations (CFR) Part 135. The eight passengers, the airline transport rated captain, and the commercial rated first officer were not injured. Day visual meteorological conditions (VMC) prevailed at the time of the accident, and an instrument flight plan had been filed but not activated.

The flight originated from the Daniel K Inouye International Airport (HNL) in Honolulu, HI, about 0947 HST. A picture of the direct route is shown in Figure 1. The recorded ground track recovered from the airplane's Garmin G1000 integrated flight instrument system is shown in Figure 2.

(Note: Times in the study are quoted in HST. HST = Greenwich Mean Time – 10 hr.)

D. THE AIRPLANE

A picture of the accident airplane, a Cessna 208B Grand Caravan EX, is shown in Figure 3. The airplane was manufactured by Cessna in 2013.

¹ The International Civil Aviation Organization four-letter airport codes for the American North Pacific region begin with the letter "P". The "P" has been dropped from the airport codes in this study. The FAA identifier for Kapalua airport is JHM.

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E. WEATHER SUMMARY

ASOS PHJH 182045Z 05012KT 10SM FEW030 FEW040 31/18 A3001

The automated surface weather observation at Kapalua airport on August 18th at 1045 HST was wind 050° at 12 knots (kt); 10 statute miles visibility; a few clouds at 3,000 feet (ft) above the ground (agl); a few clouds at 4,000 ft agl; temperature 31° Celsius (C); dew point 18° C; altimeter 30.01" mercury.

F. PERFORMANCE STUDY

The data used in the airplane performance study were recovered from the airplane's Garmin G1000 integrated flight instrument system. The G1000 contained time, position, altitude, attitude, airspeed, acceleration, and engine parameters for the accident flight. The system did not record propeller blade angle.

The runway markings, including the runway threshold, are shown in Figure 4. Figures 5 and 6 show the airplane's ground track recorded on the G1000 during the approach to Kapalua airport's runway 2 as well as the final off-runway resting place of the airplane. A rear view of the airplane in a ditch is shown in Figure 7.

Altitude, airspeed, and airplane attitude for the entire flight are shown in Figures 8 and 9. Flight 504 remained below 6,000 ft altitude most of the time, and the rate of climb varied between +/- 1,500 feet per minute (fpm) until it reached 2,000 fpm in the final descent.

Figure 10 highlights the final two minutes of the flight and shows that the indicated airspeed was approximately 115 kt when the airplane was crossing over the runway threshold² at 1037:39. The touchdown "window" is shown by the vertical red lines³.

The normal acceleration⁴ recorded on the G1000 is shown in Figure 11. The touchdown point could not be determined by normal acceleration alone. However, position, airspeed, engine torque⁵, and airplane pitch data shown in Figures 6, 10, 12, and 13, respectively, suggest that the airplane touched down between 1037:45 and 1037:49 HST. The airplane was approximately two thirds down the 3,000 ft runway at touchdown.

Assuming the accident airplane touched down 2,000 ft from the runway 2 threshold, only 1,000 ft remained for stopping. The Performance section of the Grand Caravan Pilot Operating Handbook and FAA Approved Flight Manual indicate that the (landing) ground roll with

² Mokulele airlines trains their pilots to cross the threshold at Kapalua no faster than 85-90 KIAS.

³ The Mokulele airlines application for viewing flight data indicate a touchdown, i.e., zero vertical speed, around 1037:41. However, the G1000 data show a vertical speed of -442 fpm at 1037:41. Zero vertical speed occurs at approximately 1037:49 in the recovered G1000 data.

⁴ Normal acceleration is typically around 1g in cruise flight. However, the normal acceleration recorded by the G1000 system has a mean of zero.

⁵ Torque is a measurement of rotational force exerted by the engine on the propeller.

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landing flaps⁶ is approximately 1,070 ft. This assumes an indicated airspeed of 78 kt at 50 ft over the runway threshold.

G. SUMMARY AND CONCLUSIONS

The crew of Mokulele airlines flight 504 crossed the runway 2 threshold at Kapalua airport at about 115 kt, between 25 and 30 kt faster than current company guidance. The airplane touched down about 2,000 ft down the runway before overrunning the end of the 3,000 ft runway. Landing performance data from the airplane manufacturer indicate that there was not enough runway remaining to stop the airplane.

Recorded engine data show that engine torque increased around the time of touchdown; however, propeller blade angle is not recorded. As a result, the position of the propeller could not be determined, e.g., below effective thrust angle or “BETA” mode⁷.

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⁶ The accident airplane used approach flaps, not landing flaps. While Textron does not publish landing distances with approach flaps, distances would increase with approach flaps.

⁷ BETA mode is the engine operational mode in which propeller blade angle is controlled by the power lever. BETA mode is used to slow the airplane by reversing propeller thrust and may only be used during ground operations.

H. FIGURES



Figure 1: Mokulele Airlines Flight 504 from Inouye International Airport (HNL) to Kapalua Airport (HJH)



Figure 2: Mokulele Airlines Flight 504 Ground Track Recorded on Recovered G1000

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Figure 3: Accident Airplane, N879MA, a Cessna 208B Grand Caravan EX

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Figure 4: Kapalua Airport (HJH)

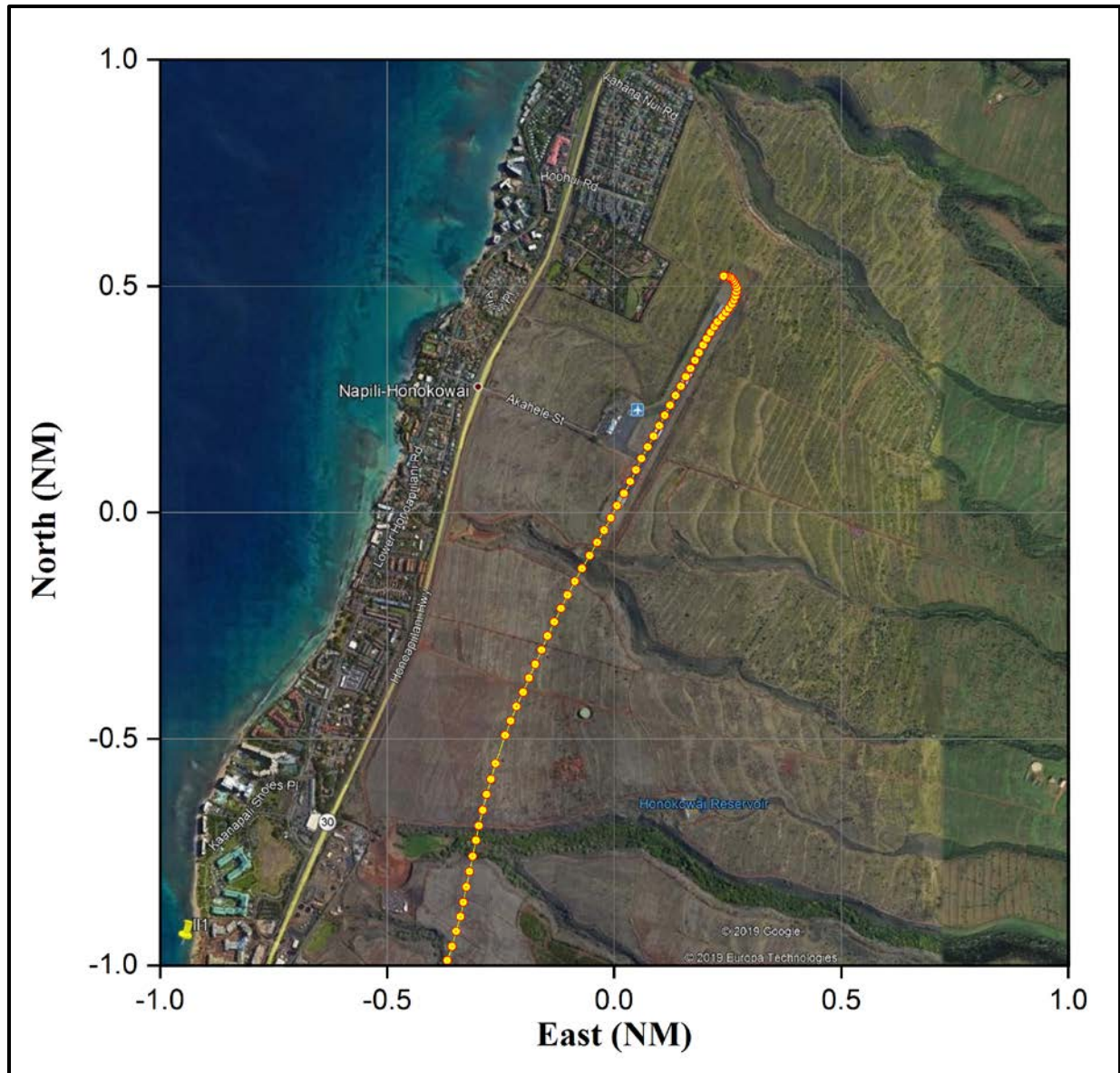


Figure 5: Kapalua Airport with Ground Track Recorded on Recovered G1000

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Figure 6: HJH with Time (HST) /Altitude (ft) / Indicated Airspeed (kt) Recorded on G1000
(Note: runway slopes up approximately 15 ft from runway 2 threshold to runway 20.)



Figure 7: Rear View of the Airplane in a Ditch (Photo courtesy of the operator.)

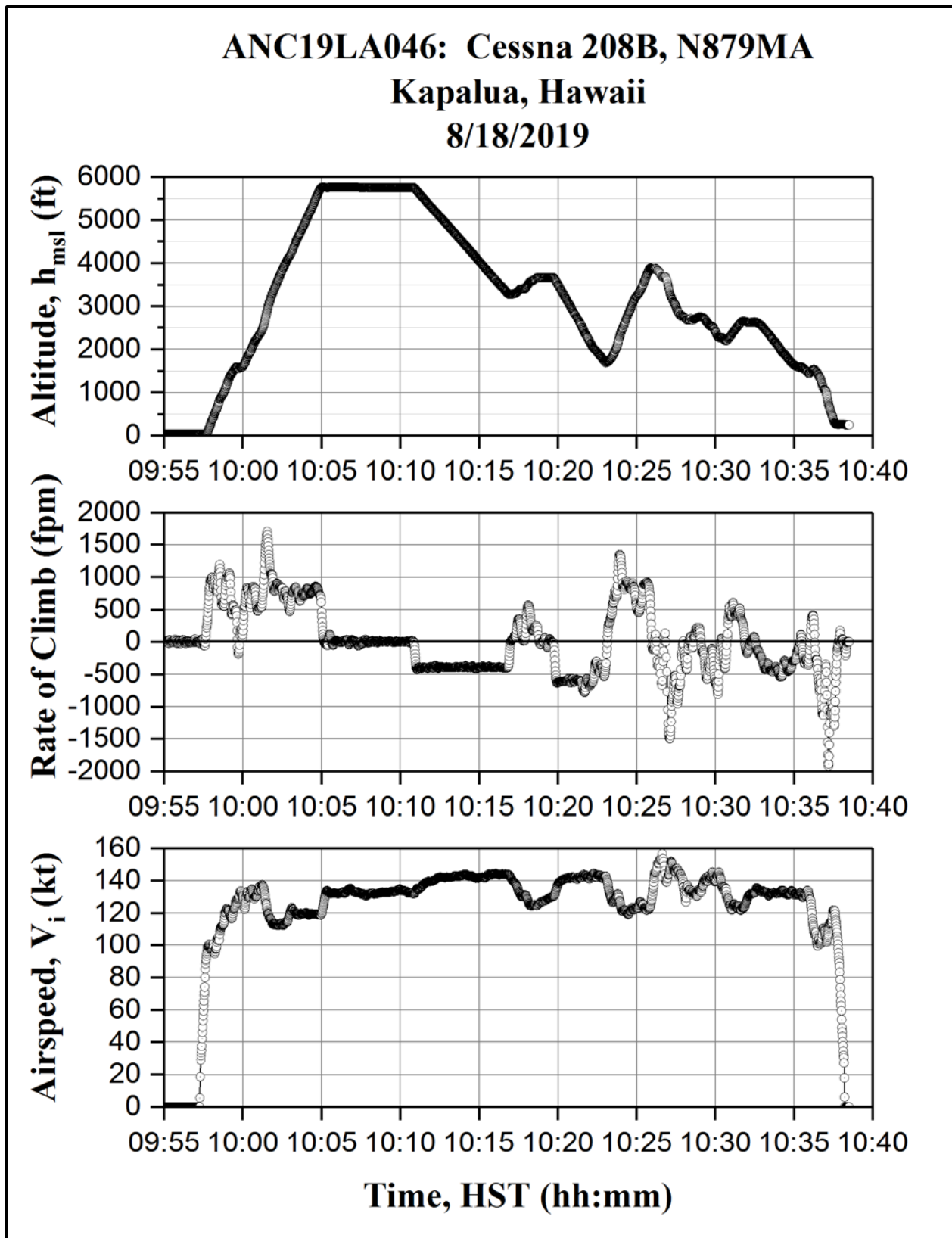


Figure 8: Altitude and Airspeed for Entire Flight Recorded on Recovered G1000

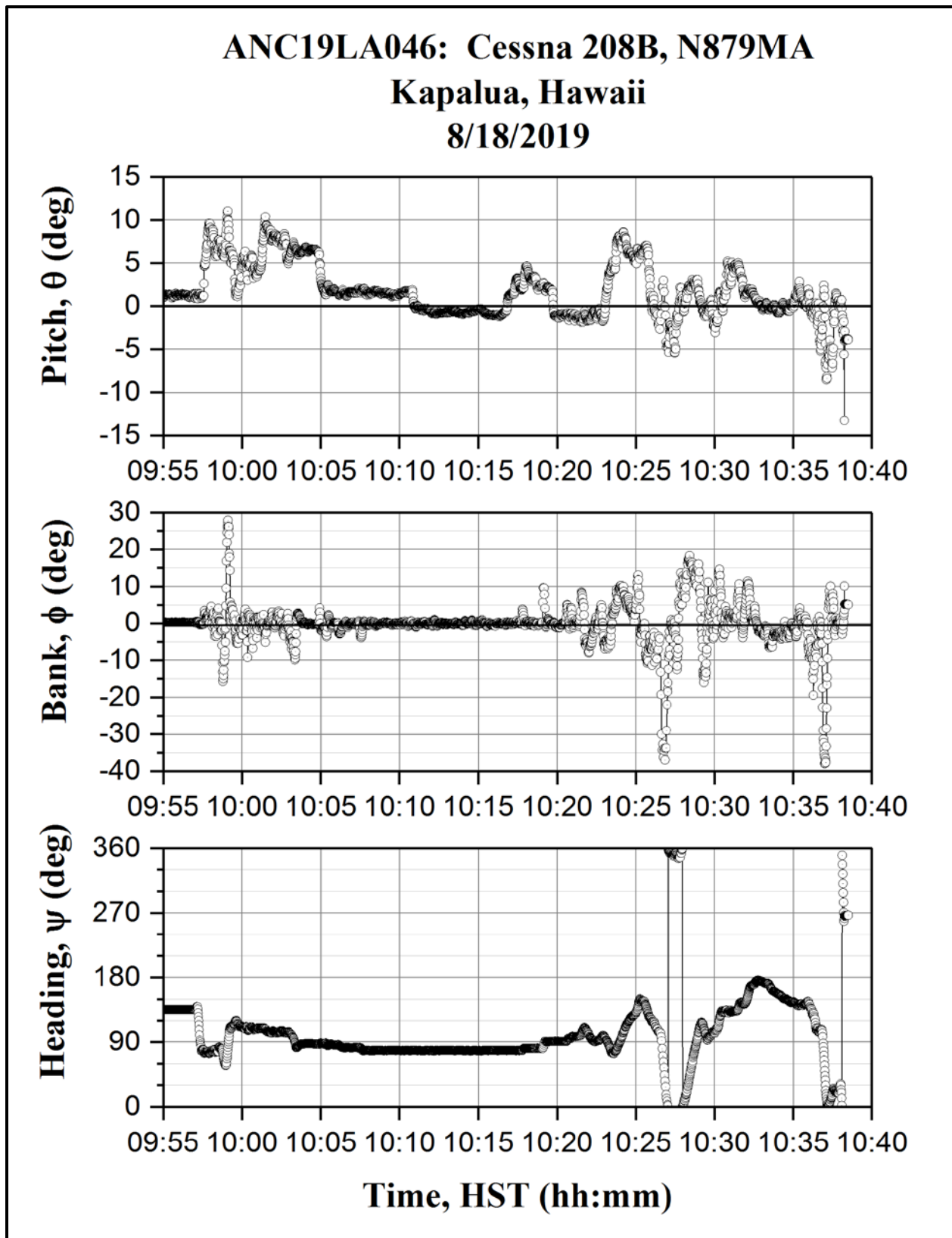


Figure 9: Airplane Attitude for Entire Flight Recorded on Recovered G1000

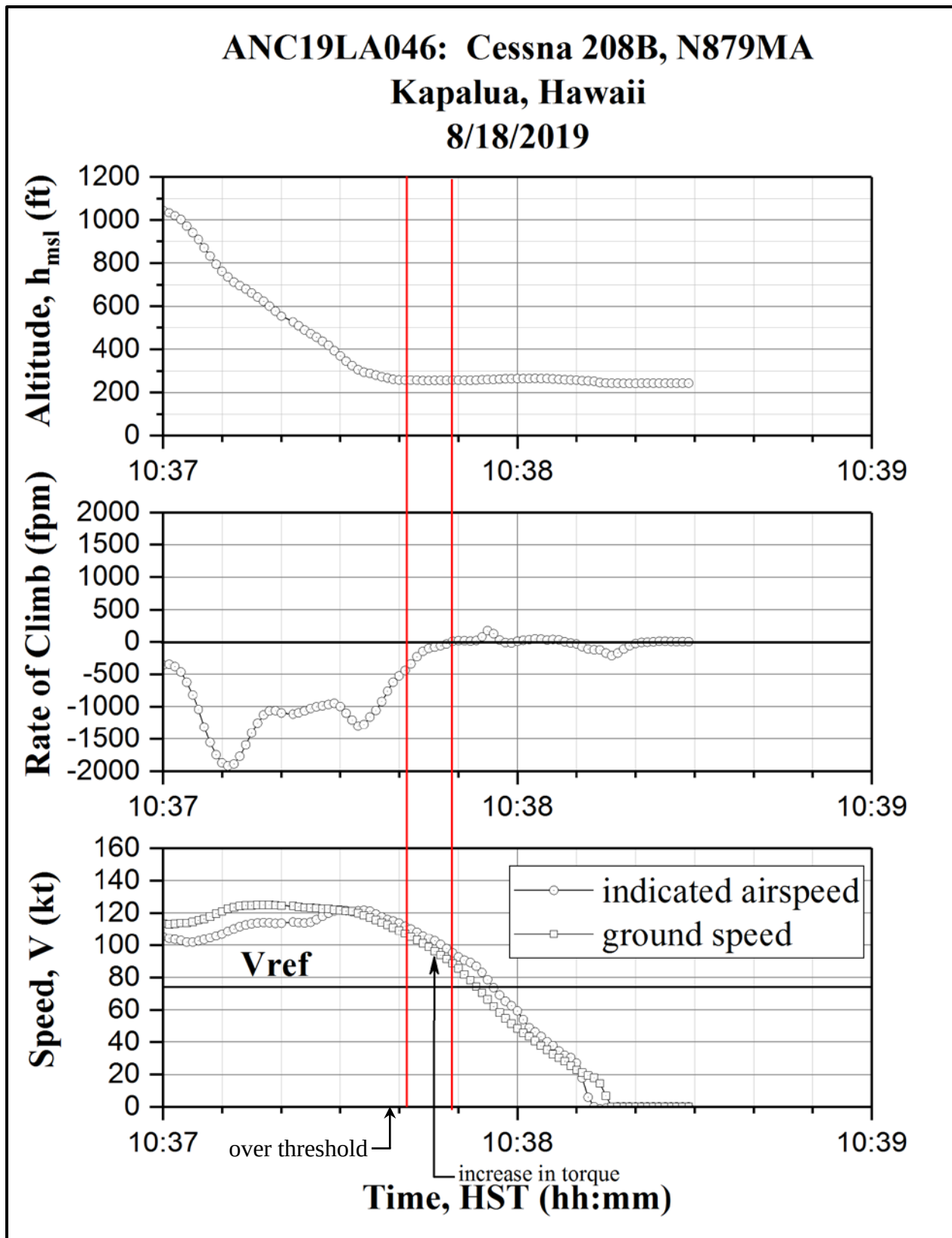


Figure 10: Altitude and Speed for Final Two Minutes with Touchdown Estimate

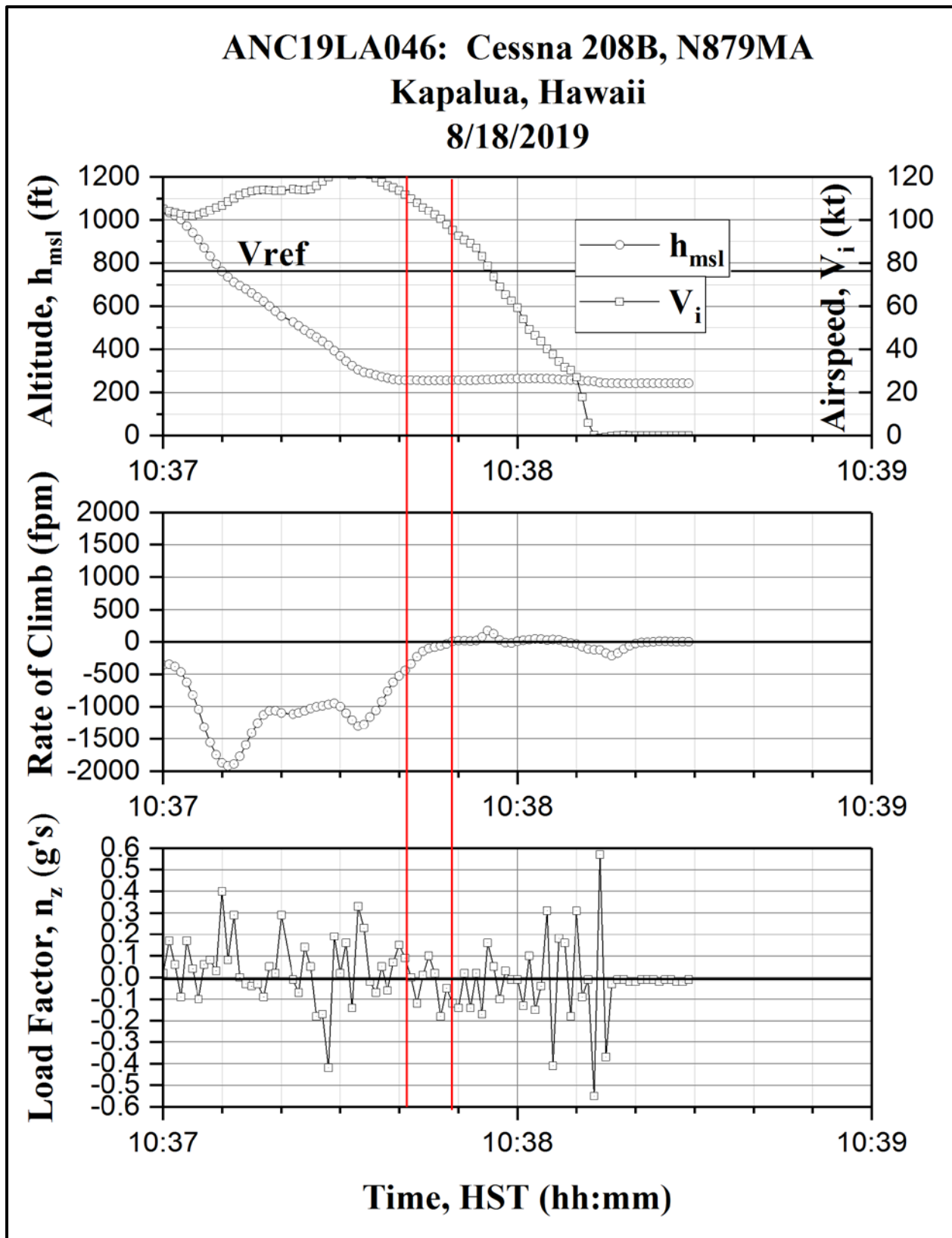


Figure 11: Altitude and Load Factor for Final Two Minutes with Touchdown Estimate

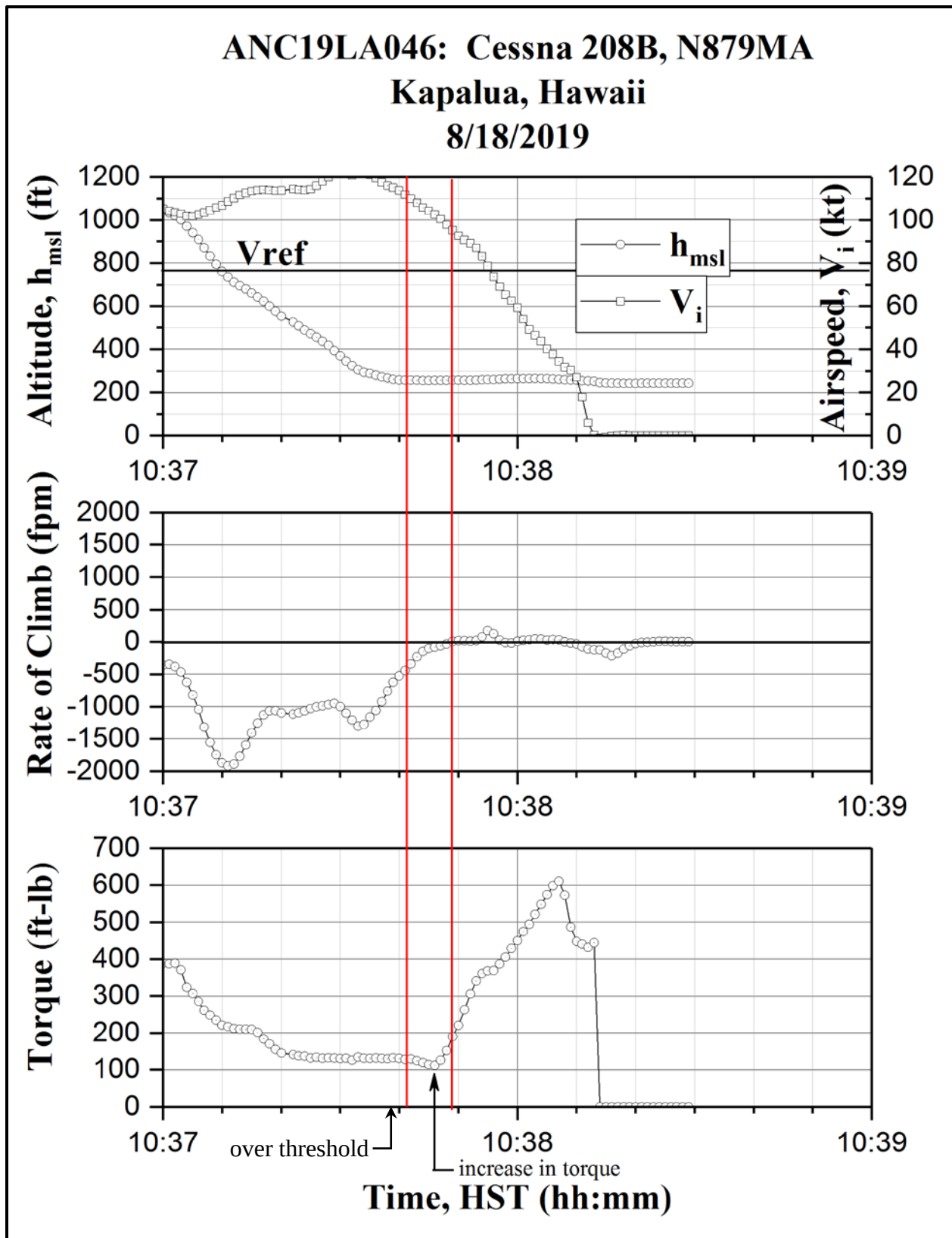


Figure 12: Altitude and Engine Torque for Final Two Minutes with Touchdown Estimate

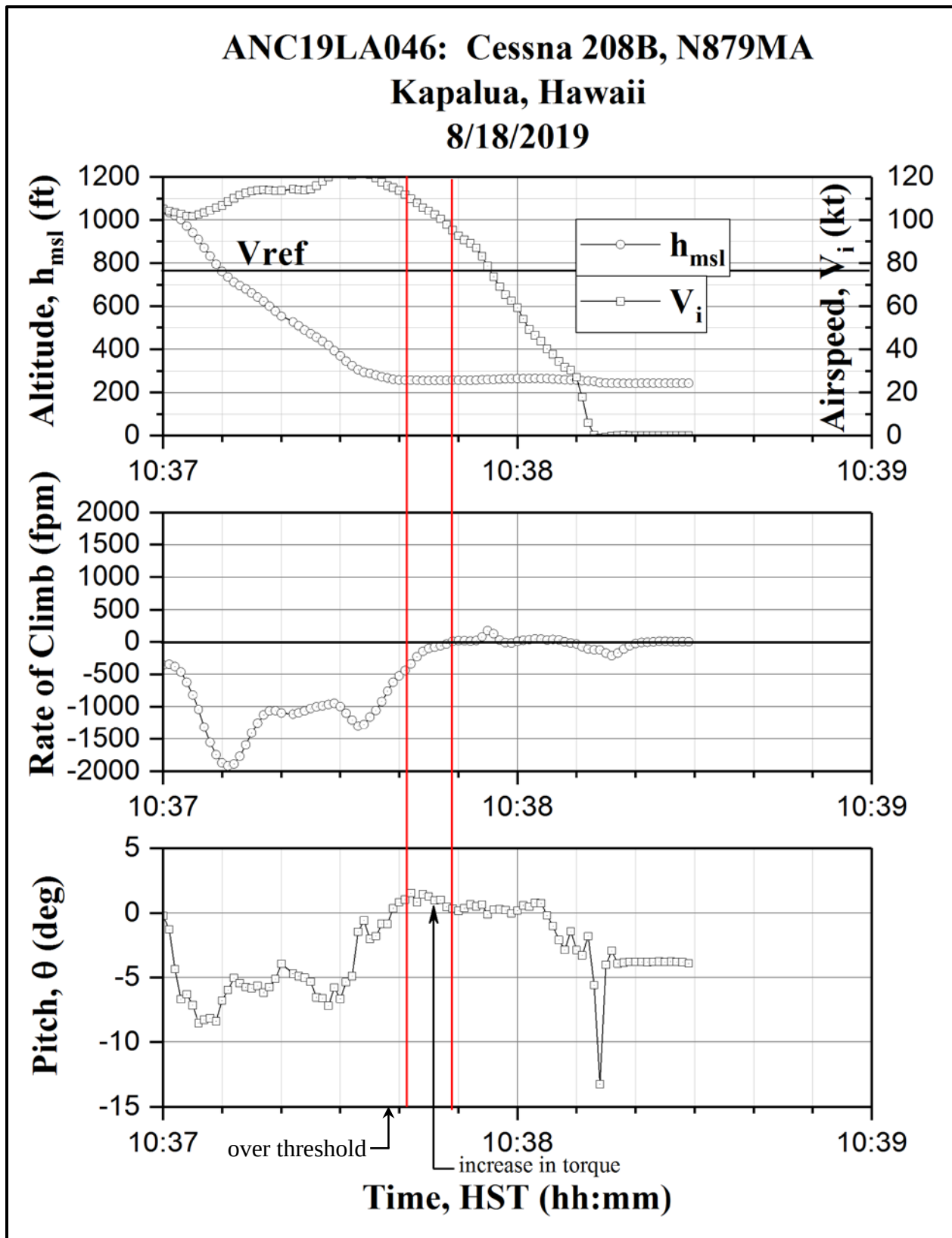


Figure 13: Altitude and Pitch for Final Two Minutes with Touchdown Estimate