National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594

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VIDEO STUDY

by Dan T. Horak

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TABLE OF CONTENTS

A. ACCIDENT

Location: Oroville, California
Date: June 2, 2022
Time: 1218 Pacific daylight time
Aircraft: Beechcraft 19A

B. SUMMARY

B.1. The accident

On June 2, 2022, about 1218 Pacific daylight time, a Beechcraft 19A Musketeer airplane, N7641R, was substantially damaged when it was involved in an accident near Oroville Municipal Airport (OVE), Oroville, California. The pilot and pilot-rated passenger were fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

B.2. Objective and scope of the *Video Study*

The objective of this Video Study was analyzing the condition of the engine of an airplane that crashed shortly after taking off. Analysis was based on the sound stream in a video recorded by a bystander with a hand-held phone.

C. DETAILS OF THE INVESTIGATION

The analysis was based on a video that was recorded with a hand-held phone. The video had 1920x1080 resolution and frame rate of 60 frames per second (fps). The video lasted 150 seconds. The airplane started its takeoff roll at video time 75 seconds and it lifted off at about time 115 seconds. The airplane was last in the field of view of the camera at time 141 seconds. Past that time, the camera holder's voice recorded in the video indicated that he knew that the airplane was experiencing problems and he stopped filming it. The audio in the video was sampled at the rate of 48,000 samples/second. Figure 1 shows an aerial view of the accident area. It shows three locations of the airplane that was taking off on runway 13. The locations are labeled with the video times when the airplane was there.

C.1. Signal intensity

Figure 2 shows the sound signal intensity and its root mean square (rms) value during the 150-seconds-long video. The rms has its maximum value at about video time 114 seconds, just past the time when the airplane was closest to the camera as seen in Figure 1. Past 114 seconds, the airplane was moving away from the camera and, therefore, decreasing sound intensity was expected. However, Figure 2 shows that the intensity signal reached its highest value at about time 150 seconds and the rms level at that time was about four times higher than what it was 20 seconds earlier, at time 130 seconds. This unexpected intensity increase could be an indication of engine problems.

C.2. Signal spectrum

The spectrum of the signal was analyzed in an attempt to provide more information on the cause of the increasing signal intensity as the airplane was flying away from the camera location. Figure 3 shows sound signal spectra computed with the Fast Fourier Transform (FFT) algorithm in analysis windows with starting times from 102 seconds to 124 seconds. The 65536-point analysis windows were 1.3653 seconds wide and the frequency resolution was 44 cycles/minute (cpm). The window starting at time 114 seconds corresponds to the time when the airplane was close to the camera and, therefore, the Doppler effect was negligible. The frequency of the first spectral peak is 5000 cpm. Since the airplane used a two-bladed propeller, the engine speed at that time was 2500 rpm.

When the airplane was close to the camera, the spectrum consisted of the 5000 cpm peak and peaks at the harmonics of 5000 cpm. The FFT magnitude at other frequencies was negligible. This indicates that the engine was operating smoothly so that its combustion and exhaust sounds were negligible compared to the sound generated by the propeller blades.

At time 124 seconds, the blade passage frequency became less dominant in the spectrum. Figure 4 show sound signal spectra in windows with starting times from 126 seconds to 148 seconds. The figure shows that past time 140 seconds, the spectrum included components at higher frequencies than before that time. The spectrum in the window starting at time 142 seconds is especially interesting because of the elevated FFT magnitudes near 22,000 cpm and near 33,000 cpm. These spectral characteristics could be indications of engine problems. However, they could not be reliably associated with any specific engine failure modes. It is possible that the engine was emitting sound signals that carried information on a specific failure mode, however, by the time the signal reached the microphone over the increasing distance, that information was lost.

D. CONCLUSIONS

The sound emitted by an airplane that crashed a short time after takeoff was analyzed. The engine speed was 2500 rpm when the airplane became airborne and the engine was operating smoothly. About 25 seconds past liftoff and later, the airplane sound intensity was elevated, and the sound spectrum included components at frequencies higher than before. The elevated intensity and spectral components at higher frequencies could be indicative of engine problems. However, they could not be associated with specific engine failure modes.

FIGURES

Figure 1. Aerial view of the accident area

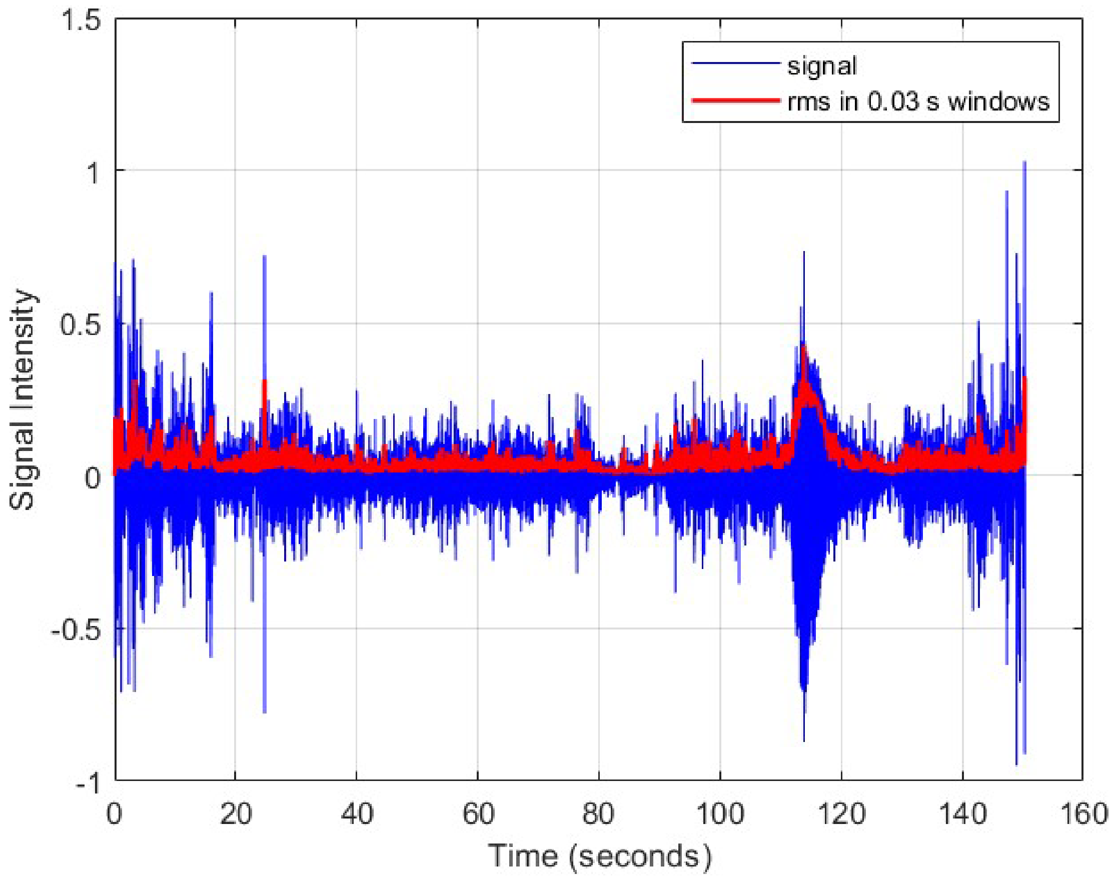

Figure 2. Signal intensity

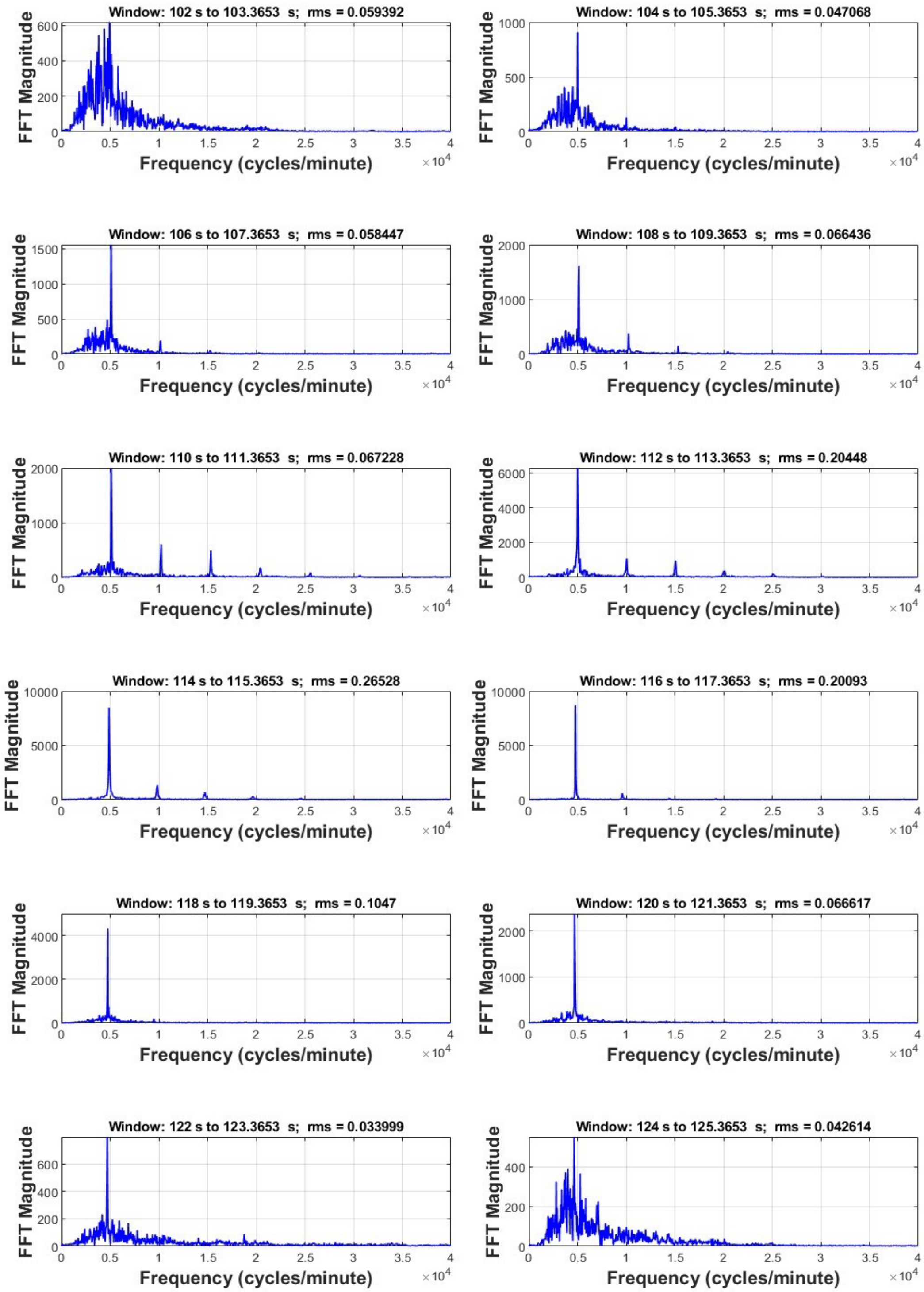

Figure 3. Sound spectra in windows starting at time 102 seconds

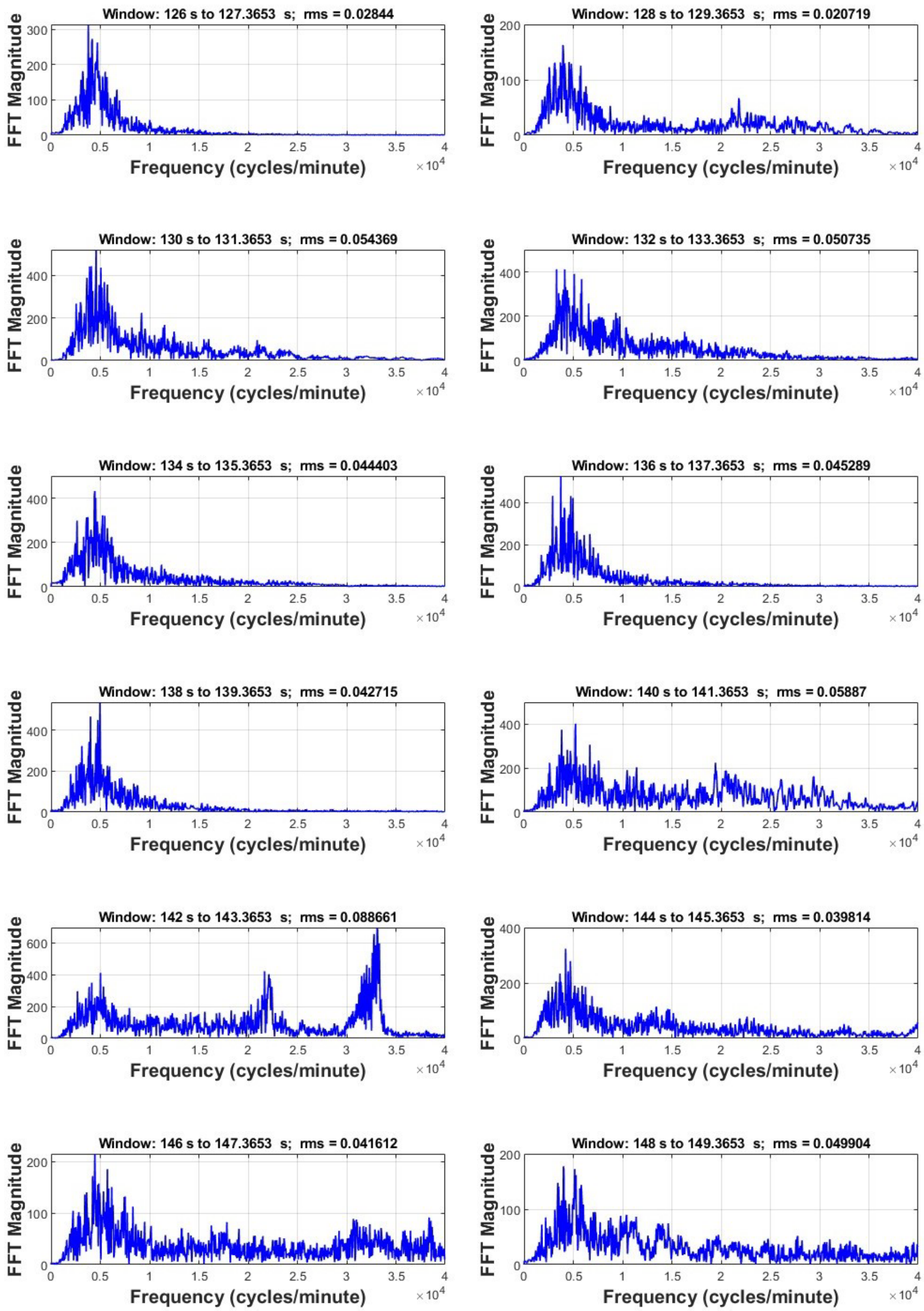

Figure 4. Sound spectra in windows starting at time 126 seconds